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AUGUST, 1898. VOL. XII. NO. 2.

The Geographical Journal

INCLUDING THE PROCEEDINGS OF THE ROYAL GEOGRAPHICAL SOCIETY.

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(For Details, see over.)

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ON THE ANNUAL RANGE OF TEMPERATURE IN THE SURFACE WATERS OF THE OCEAN, AND ITS RELATION TO OTHER OCEANOGRAPHICAL PHENOMENA.*

By Sir JOHN MURRAY, K.C.B., F.R.S., LL.D., D.Sc.

(*Of the "Challenger" Expedition.*)

1. Introductory.

Temperature may be defined as that state of matter on which depends its relative readiness to give or to receive heat. Variations of temperature are intimately associated with all changes in nature, and no investigation is more important or more interesting to the scientific man than the study of these temperature variations, and their relation to other natural phenomena. In the present communication, it is proposed to consider with some detail the temperature variations which take place in the surface waters of the ocean during the course of the year, and to indicate some of the physical and biological phenomena which appear to be directly or indirectly connected therewith.

On the dry land there is often a very wide *daily* range of temperature in the air immediately resting upon the ground. The temperature at the surface of the sandy deserts of the tropics frequently rises during the day to 120° or 140° Fahr., and more rarely to 200° Fahr.; and when these hot particles of dust are lifted into the air by winds, the temperature of the air rises occasionally to 125° Fahr. in the shade, while during the night the temperature sometimes falls below the freezing-point. Rock surfaces in the tropics, which during the day are heated up to 137° Fahr., are cooled so rapidly by radiation at night that, unable to sustain

* Read at the Royal Geographical Society, February 28, 1898. Map, p. 224.

the strain of contraction, they split, and throw off sharp angular fragments from a few ounces to 100 or 200 lbs. in weight.* Cold rain falling on these sun-heated rocks produces a similar effect.† At Atacama, in South America, a range of temperature amounting to 91° Fahr. has been recorded in four hours.‡

The *annual* range of temperature is likewise very great at some places on the land-surfaces. At Werkojansk, in Siberia, the range of temperature between the mean of the coldest month and the mean of the warmest month is 120° Fahr.; and at this place, in February 1892, the temperature fell to – 93°·6 Fahr., being absolutely the lowest temperature of the air hitherto recorded. The *extreme* range of temperature of the air which may be found upon the land-surfaces as a whole, as distinct from the daily or annual range at any one spot, is known to exceed 220° Fahr.

When we turn to a consideration of the changes of temperature which occur in the surface waters of the ocean, it is found that these are much less rapid, and that the *daily* and *annual* range at any one spot, and the *extreme* range of temperature from equator to pole, are all very much less than on the land-surfaces. This result is due to the great thermal capacity of water, and to the fact that most of the light and heat rays are absorbed on passing through the surface-layers of the water. The high specific heat of water precludes such a rapid rise or fall of temperature as takes place on land. When the temperature of the water is raised, evaporation tends to check the rapidity of the rise; when the temperature falls, condensation of the superincumbent vapour checks the rapidity of the fall, and, when a low temperature is reached, freezing sets in, again retarding the fall.

The mean *daily* range of temperature in the surface-waters of the North Atlantic, as determined from the *Challenger* observations, made on 126 days from March to August, 1873, and in April and May, 1876 (mean lat. 30° N., mean long. 42° W.), was only 0°·8 Fahr.; while the amplitude of the daily variation in the temperature of the air over the sea on the same 126 days was 3°·21 Fahr., or four times greater than that of the sea over which it lies.§ During this time the *Challenger* was near land on 76 days, and on these days the diurnal variation was 4°·38 Fahr., thus showing a larger range in the temperature of the air when near land than when out in the open sea. An examination of the temperatures taken by the *Challenger* in other parts of the globe renders it highly probable that nowhere in the open ocean does the

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* Livingstone, 'Zambesi,' pp. 492, 516. London: 1865.

† Stanley, *Proc. R. G. S.*, vol. xx. p. 142, 1876.

‡ Viz. from 7° Fahr. at 7 a.m. to 98° Fahr. at 11 a.m. (J. Harding, *Jour. R.G.S.*, 1877, p. 252).

§ See Buchan in Challenger Report: Narrative, vol. i. pp. 998, 999, 1885; also his "Report on Atmospheric Circulation," *Phys. Chem. Chall. Exp.*, part v. pp. 4–8, 1889.

mean daily fluctuation of the temperature of the surface water amount to 1° Fahr.; hence, the atmosphere over the ocean may be regarded as resting on, or blowing over a surface, the temperature of which is practically uniform at all hours of the day, being thus a striking contrast to what takes place on the dry land.

The *annual* range of surface temperature in the ocean within any particular 2° square, so far as recorded, does not exceed 53° Fahr.: this greatest annual range being found off the Banks of Newfoundland in the Atlantic, and in the Japan seas in the Pacific—at places where the surface is occupied by cold waters coming from polar areas at one season, and by warm waters coming from tropical areas at another season; but we shall presently show that there are large areas, both in the tropics and polar regions, where the annual range does not exceed a few degrees during the course of the year. The *extreme* range of temperature recorded in the ocean is about 70° Fahr.: from the freezing-point of salt water in the polar regions to 96° Fahr., recorded at the head of the Persian Gulf.

The much greater range of temperature on the surface of the continents than in the surface and subsurface waters of the ocean, might lead one to expect that the distribution of land organisms would be more limited by temperature conditions than that of marine organisms. Such—at first sight, at all events—does not, however, appear to be the case. It has long been recognized that the mean annual temperature, or the annual range of temperature, in any area on the land surfaces produces a very marked effect on the character of the fauna and flora; still, zoologists have, as a general rule, considered topographical features as the most important factor in limiting the distribution of species, while botanists, on the other hand, have considered temperature conditions as the most important factor. The various zoological provinces, into which naturalists have divided the land-surfaces, have been laid down chiefly from a study of warm-blooded and air-breathing animals, which are able to maintain a nearly uniform temperature of their bodies under great variations in the external temperature conditions. If we except hybernation, there is even a rise in the temperature of the body, and an increase in metabolism in Mammalia, with a lowering of the external temperature. Topographical features, such as mountain ranges, deserts, and seas, seem therefore to be more important factors in determining the limits of distribution of terrestrial species than mere temperature or climatic conditions.

In the ocean there are very few warm-blooded and air-breathing animals, and we have to deal chiefly with cold-blooded animals, the temperature of whose blood rises and falls with that of the surrounding water; hence temperature conditions—even with the lesser variation in range—appear to be, as with plants, the most important factor in limiting the distribution of marine animals. In this connection, the following may be indicated as one of the many interesting problems

presented to the naturalist. In the tropics a marine animal—a copepod or isopod, for instance—lives constantly in water at a temperature of about 70° Fahr.; in the polar seas, a similar animal lives as constantly in water at a temperature about zero. What is the difference in the rate of metabolism, length of life, rate of reproduction, and general life-history of the two animals? There seems to be little doubt that a satisfactory reply to these questions would explain many of the observed differences between polar and tropical faunas.

The above and some other allied considerations, together with the desirability of having a more precise knowledge of the variations in the range of temperature in different regions of the ocean, induced me some years ago to attempt the preparation of a map showing the annual range of temperature in the surface waters of the ocean within every two-degree square on the water surface of the globe; for it seemed that a comparison of the range of temperature in different places at the surface of the ocean might possibly show an intimate connection with other oceanographic phenomena.

2. Preparation of the Range-Map from Temperature Observations in Every 2° Square.

A first attempt was made by using the Charts showing the surface temperature of the Atlantic, Indian, and Pacific Oceans, published by the Meteorological Council in 1884. In these charts the mean temperature and range are given for the four different months, February, May, August, and November, as recorded within each 2° square throughout the three oceans; in some localities numerous observations made it possible to give the results within smaller areas. In order to arrive at the extreme annual range within each 2° square, the figures were used in the following manner: Taking the map for February, the maximum and minimum temperatures for any particular 2° square in that month were obtained by adding half the given range to the mean temperature for the maximum, and by subtracting half the given range from the mean for the minimum. This operation was repeated with the maps for May, August, and November, and the four maxima and the four minima were entered on specially ruled paper. The extreme range shown by these four sets of figures was laid down on a blank map as the approximate annual range of surface temperature in each 2° square, and lines were drawn for intervals of 10° Fahr. of range of temperature, in the same manner as the lines on the map accompanying this paper.

A map constructed on this principle was exhibited at a lecture, on the structure, origin, and distribution of coral reefs and islands, delivered before the Royal Institution of Great Britain, in London, on March 16, 1888, with special reference to the range of temperature within the coral-reef regions. On careful consideration this map was not published. The method was rejected as unsatisfactory, because the given mean

temperature is not the arithmetical mean between the maximum and minimum temperatures observed in any particular 2° square, but the mean of all the observations, and therefore the maximum brought out by this method may be too high, or the minimum may be too low, according as the great majority of the observations were high or low. For example, in the North-West Atlantic (lat. 42°–44° N., long. 48°–52° W.) a mean temperature of 35° Fahr. is given for the month of February, with a range of 27°; deducting half the range from the mean gives a minimum temperature of 21½° Fahr.—an impossible temperature at the surface of the sea.

Subsequently, an application to the Meteorological Office in London resulted in an arrangement being made, whereby the maximum and minimum surface temperatures for each 2° square throughout the great ocean basins were extracted from the records in that office for the two months likely to give the extremes of temperature, viz. February and August.* These maxima and minima were laid down on maps, and the extreme ranges of temperature shown by these figures were placed in geographical position on other maps, lines being drawn enclosing those regions in which

(1) the recorded range does not exceed 5° Fahr.
(2) " " is between 5° and 10° Fahr.
(3) " " " 10° " 15° "
(4) " " " 15° " 20° "
(5) " " " 20° " 25° "
(6) " " " 25° " 30° "
(7) " " " 30° " 35° "
(8) " " " 35° " 40° "
(9) " " " 40° " 45° "
(10) " " " 45° " 50° "
(11) " " is over 50° Fahr.

In this manner the data supplied by the Meteorological Office, supplemented by information from other sources as indicated in the succeeding paragraphs, have been made use of in preparing the map accompanying this paper, which represents very approximately the annual range of temperature in the surface waters of the ocean throughout the world.

The method adopted in making use of the supplementary information referred to, was to extract the maximum and minimum temperatures recorded in any 1° square throughout the world, and to enter them on

* The maximum and minimum effects of temperature appear to take place in the water about a month later than in the atmosphere, so that, after consultation with Dr. Buchan, the months of February and August were chosen as the most suitable for our purpose.

I am much indebted to the members of the Meteorological Council, and to the officers of the Department, for the permission and assistance given in consulting the records in their possession.

sheets of specially ruled paper. Each sheet was ruled so as to contain in convenient form the maxima and minima within a 10° square, the observations being inserted for each 1° square, while the sheet was subdivided by rulings into 2° squares. Thus, at a glance, the range within any 1° square, or any 2° square, or any 10° square, was available. These sheets have been kept up to date by the inclusion of observations from other sources, and, by including all future observations, they can at any time be made available for the revision and correction of the map. On these sheets, maxima and minima collected from every available source have been entered. We may specially mention the observations of surface temperature in the North Pacific, collected together by Admiral Makaroff in his Report on the voyage of the *Vitiaz* in the North Pacific (published in 1894); the observations published annually in the Admiralty Blue-books (Lists of Oceanic Depths and Temperatures received at the Hydrographic Office); and Prof. Mohn's observations of surface temperature in the Norwegian Sea (published in the Report of the Norwegian North Atlantic Expedition).

In 1895 Dr. Schott published a paper on "Die jährliche Temperaturschwankung des Ozeanwassers" in *Petermann's Mitteilungen* (vol. xli. p. 153), and his map is, so far as we are aware, the only attempt to represent graphically the variation of temperature at the surface of the sea, but it has evidently been prepared from *mean* monthly temperatures, and not from extreme temperatures; the range shown on his map is therefore necessarily less than that shown on the map accompanying this paper.

The total number of observations of surface temperature represented by the figures laid down on our charts is very large, and it is very difficult to arrive at even an approximation; but, with the aid of Makaroff's Tables, an attempt has been made to estimate the minimum number of observations in the North Pacific, as set forth, in zones of 10° of latitude, in the following table:—

NUMBER OF OBSERVATIONS OF SURFACE TEMPERATURE IN THE NORTH PACIFIC, AS RECORDED BY MAKAROFF (1894).

Lat. 0° to 10° N.	2,557	observations.
„ 10° „ 20° „	2,866	„
„ 20° „ 30° „	4,773	„
„ 30° „ 40° „	7,722	„
„ 40° „ 50° „	13,970	„
„ 50° „ 60° „	5,867	„
„ 60° „ 70° „	1,085	„
„ 70° „ 76° „	34	„
Total	38,874	

In the above numbers, those cases where observers have given simply a mean for the twenty-fours have been counted as a single

observation, though in reality that mean represents several observations. In addition, there are many cases where the number of observations is not recorded, though a maximum or a minimum temperature, or both, are given; these have been counted as one or two observations, according as one or two readings are given. Therefore the numbers in the preceding table are probably considerably below the truth; but, looking upon them as approximately correct, it appears that the number of observations increases from the equator northwards to between 40° and 50° N., where a maximum of nearly 14,000 observations is reached, from whence the number rapidly decreases northward. Northwards of 70° N. only thirty-four observations had been recorded in 1894, and to the north of 76° no observations were recorded.

But a better idea of the amount of material made use of in preparing the accompanying map will be formed from an examination of the table on p. 120, showing (1) the number of 2° squares in which observations are recorded in the two opposite months of February and August, (2) the number of 2° squares in which observations are recorded in the one or the other of these two months, and (3) the number of squares which are blank as regards observations in these two months, between the latitudes of 60° N. and 60° S. in the three great oceans.

From this table it appears that in the 2° squares, which contain water-surfaces, between lat. 60° N. and 60° S., observations are available in considerably more than half of the total number in the two months specified, while in nearly one-fourth of the total number of squares observations are available in only one of these months, and in the remaining one-fifth there are no observations available. To be more exact, of the total number of squares 56 per cent. contain observations in the two opposite months, 23 per cent. contain observations only in one of these months, and 21 per cent. contain no observations in these two months. A fairer estimate would, perhaps, be obtained by excluding the zone between 50° and 60° S., in which zone, more particularly in the Indian and Atlantic oceans, large tracts are blank. Thus, of the total number of 2° squares between the latitudes of 60° N. and 50° S., 59 per cent. contain observations in the two opposite months, 24 per cent. contain observations in only one of these months, and 17 per cent. contain no observations in these two months.

Considering now the figures relating to each of the great oceans, it appears that of the total number of 2° squares which contain water-surfaces in the Indian ocean between 30° N. and 60° S., 70 per cent. contain observations in the two opposite months, 13 per cent. contain observations in one only of the two months, and 17 per cent. contain no observations in these months. The large amount of information regarding the surface temperature of the Indian ocean is prominently brought out by excluding the zone between 50° and 60° S., which is almost a complete blank; for it appears that of the total number of 2°

Zone of latitude.	Number of 2° squares in which observations of surface temperature are recorded in two opposite seasons.				Number of 2° squares in which observations of surface temperature are recorded in one season only.				Number of 2° squares in which no observations of surface temperature are recorded.			
	Atlantic.	Indian.	Pacific.	Total.	Atlantic.	Indian	Pacific.	Total.	Atlantic.	Indian.	Pacific.	Total.
60° to 50° N.	83	—	130	213	84	—	34	118	6	—	59	65
50° „ 40° N.	154	—	197	351	26	—	37	63	8	—	23	31
40° „ 30° N.	195	—	151	346	21	—	82	103	7	—	68	75
30° „ 20° N.	174	34	171	379	32	8	94	134	10	5	80	95
20° „ 10° N.	130	110	169	409	42	8	132	182	9	3	105	117
10° „ 0° N.	109	98	156	363	32	29	136	197	4	6	160	170
0° „ 10° S.	73	135	78	286	41	47	132	220	20	15	185	220
10° „ 20° S.	78	156	88	322	36	30	157	223	17	16	146	179
20° „ 30° S.	110	163	124	397	22	41	135	198	12	16	87	115
30° „ 40° S.	147	259	231	637	18	4	106	128	5	—	56	61
40° „ 50° S.	105	219	271	625	39	21	110	170	48	5	34	87
50° „ 60° S.	45	2	230	277	4	43	68	115	151	230	126	507
Total ...	1403	1206	1996	4605	397	231	1223	1851	297	296	1129	1722

squares in the Indian ocean, from its northern limits to lat. 50° S., 83 per cent. contain observations in the two months of February and August, 13 per cent. contain observations in one only of these months, while merely 4 per cent. are blank as regards observations in these two months.

Of the total number of 2° squares in the Atlantic ocean between 60° N. and 60° S., 67 per cent. contain observations in the two opposite months, 19 per cent. contain observations in one only of these two months, while 14 per cent. contain no observations in the two months specified. As in the case of the Indian ocean, very few observations of surface temperature are available in the Atlantic south of lat. 50° S. Thus, of the total number of 2° squares in the Atlantic between 60° N. and 50° S., 71 per cent. contain observations in the two opposite months, 21 per cent. contain observations in one only of these months, while merely 8 per cent. are blank as regards observations in these two months.

Of the total number of 2° squares in the Pacific ocean between lat. 60° N. and 60° S., 46 per cent. contain observations in the two opposite months, 28 per cent. contain observations in one only of these months, while 26 per cent. contain no observations in these two months. The zone of latitude from 50° to 60° S. contains relatively many more observations than in the case of the Atlantic and Indian oceans, so that the exclusion of that zone does not alter the proportions in the Pacific to any appreciable extent, the percentages for the Pacific between 60° N. and 50° S. being respectively 45, 29, and 26 as compared with 46, 28, and 26 given above for the Pacific between 60° N. and 60° S.

It will thus be seen that, on the whole, the Pacific basin is the one in which our knowledge of surface temperature is most deficient, and therefore the one in which future observations may be expected to effect the greatest modifications in the map showing the range of temperature. In this ocean the greatest deficiency is within the tropics, the largest number of blank squares occurring between 10° S. and 10° N., from which zone the number of blank squares gradually decreases as far as the 50th parallels north and south; by far the larger proportion of blank squares lie within the six zones between 30° N. and 30° S. On the other hand, in the Atlantic and Indian oceans the number of blank squares is comparatively insignificant, and the blank squares are not grouped together in any particular latitude.

When we consider the recorded temperatures at different seasons of the year towards the arctic and antarctic regions north and south of the 60th parallels, our knowledge is very deficient; still a tolerably correct idea of the range of temperature within the ice-covered seas can be formed, when we remember that the minimum temperature must always be somewhere about 28° Fahr., so that the summer temperatures which have been recorded by explorers may be made use of in arriving at an

approximation of the range of temperature. In the southern hemisphere south of the 60th parallel, our maps are almost a complete blank, the observations being limited to those taken in the summer by Ross and other antarctic explorers. In the northern hemisphere, on the other hand, we have a good deal of information. As already stated, Makaroff records numerous observations north of 60° N., extending as far north as 76° N., in the North Pacific, and in the North Atlantic we have been able, approximately, to estimate the range of temperature as far as 82° N., from the observations and maps published by Mohn in the Norwegian North Atlantic Expedition Report, from Koldewey's observations during the German Arctic Expedition, from Nansen's published observations, and from records brought home by Mr. Bruce, of the Jackson-Harmsworth Expedition, as well as other arctic explorers. From these sources we have observations in no less than 155 squares between lat. 60° and 82° N., and long. 26° W. and 38° E., which are available in estimating the range of temperature.

3. General Features of the Map.

The lines on the map are drawn for intervals of 5° Fahr. of range of temperature, and different shades of colour are used for intervals of 10° Fahr. Broadly speaking, the map shows that the surface of the ocean may be divided into five great zones: firstly, a circumtropical zone with high temperature and small range (coloured deep red on the map); secondly, two circumpolar zones with low temperature and small range (coloured pale red on the map); and lastly, two intermediate zones with large ranges lying between the circumtropical and the two circumpolar zones (coloured in different shades of blue on the map).

The regions indicated as having a range of less than 5° Fahr. are largely hypothetical, more especially in the polar regions and tropical Pacific, though the small areas laid down in the tropical Atlantic and tropical Indian oceans are based upon numerous observations. In the polar regions the line coincides approximately with the line of perpetual ice.

The northern circumpolar band, with a range not exceeding 10° Fahr., borders the northern shores of Asia and America, lying mostly within the arctic circle. It is probable, however, that a wider range will be found off the mouths of many of the rivers flowing into the Arctic ocean from America and the Eurasian continent. The corresponding southern circumpolar band apparently approaches nearer to the tropics, extending northwards, approximately, as far as lat. 50° S., and penetrating to the north of that latitude in the Atlantic, but it may be expected that more extended observations will necessitate the drawing of the line of 10° range much nearer the antarctic circle, probably throughout its whole extent. In these two circumpolar bands, with a range of less than 10° Fahr., observations are meagre, and indicate

a range from about 28° to about 50° Fahr., though not exceeding 10° Fahr. in any single 2° square.

The tropical band of small range (less than 10° Fahr.) marks out approximately the coral-reef regions of the world. It forms an almost continuous belt around the globe, being broken only by the interposition of the continental masses, and for a short distance in the Pacific, off the shores of Central America. Future observations may show it to be completely broken also off the western coast of Africa, where it is now shown as continuous across the whole Atlantic. The Pacific area is the largest, stretching from near the Central American coast across to the East Indian seas and Barrier Reef of Australia (and passing through the Arafura sea into the Indian ocean), confined almost entirely within the tropics of Cancer and Capricorn, but extending beyond the latter tropic in the Central South Pacific. The observations within this Pacific tropical area show a range from 70° to 90° Fahr., though not exceeding 10° Fahr. in any single 2° square; throughout the area, however, a great many of the squares are blank, and future observations may alter the form considerably.

In the Indian ocean a belt of small range (less than 10° Fahr.) stretches across from the east coast of Africa (south of Cape Guardafui and north of Madagascar) to the shores of the Malay peninsula and Sumatra (and passing through the Arafura sea into the Pacific), lying mostly to the north of lat. 10° S., and filling up the greater part of the Arabian sea and of the Bay of Bengal. The observations within this Indian ocean tropical area show a range from 72° to 87° Fahr.

In the Atlantic the belt of small range (less than 10° Fahr.) extends across from the Caribbean sea and the north-east coast of South America to the Liberian coast of Africa, reaching northward in the central part of the ocean to the northern tropic, and southward to a little beyond lat. 20° S. The observations within this Atlantic tropical area show a range from 72° to 85° Fahr. It includes three squares, in which the recorded range just reaches 10° Fahr., all on the parallel of 10° N.

If we now turn our attention to those portions of the map which are coloured blue, where the range exceeds 10° Fahr., it will be observed that the area with a range of temperature between 10° and 20° Fahr. (indicated by the palest shade of blue) is the most extensive on the surface of the ocean. It fills up the intervals between the three bands of small range just described, and encloses in certain positions areas having a greater range. The line of 15° range cuts this pale blue area into two parts, and it will be observed that the area with an annual range exceeding 15° Fahr. lies mostly in the temperate regions between the tropics and the polar circles. The area does not reach the antarctic circle in the south, but it penetrates considerably beyond the arctic circle in the North Atlantic, extending north of the island of Jan Mayen, and in Bering strait it extends just beyond the arctic circle. In the

southern hemisphere it forms a band broken only in the centre of the South Pacific, where, however, observations are scarce, so that it may ultimately prove to be a continuous girdle round the globe.

A band with a range of over 20° Fahr. occurs in the southern hemisphere entirely south of the tropics, continuous across the South Atlantic and across the greater part of the South Indian ocean; in addition, there is an area off the south-east of Australia enclosing Tasmania, an area entirely encircling New Zealand, four small areas off the west coast of South America between lat. 10° and 50° S., and a small area off the west coast of Africa, northward of Cape Frio.

In the northern portion of the Indian ocean a range of over 20° Fahr. is found only off Cape Guardafui, extending into the Red sea, where the temperature varies from 59° to 94° Fahr., and in the Persian gulf and entrance thereto, where the temperature varies from 58° to 96° Fahr.

A large part of the North Atlantic has a range of over 20° Fahr., extending across from the Gulf of Mexico and the eastern shores of North America to the western shores of Europe and Africa, and into the Mediterranean. The eastern boundary of this area stretches from lat. 10° N., on the coast of Africa, to lat. 70° N., near the North Cape on the Norwegian coast.

In the North Pacific an extensive area, with a range of over 20° Fahr., extends across from the eastern shores of Asia to the west coast of North America, and into the Bering sea, where it reaches as far northward as lat. 64° N. There is also a small area in the region of the Gulf of California, with a range exceeding 20°, a range of 27° being recorded in the upper half of that gulf.

A range exceeding 25° Fahr. is found in various parts of the ocean, almost entirely outside the tropics, the only positions within the tropics being off Cape Guardafui and in the Red sea, and off the Chinese coast. In the North Atlantic an extensive area lies off the east coast of North America, between lat. 30° and 50° N., extending seawards beyond long. 30° W.; a second area fills the Mediterranean and Black sea; and a third area occurs in the Irish sea, English channel, North sea, Baltic sea, running up the Norwegian coast to 70° N. In the North Pacific a large area lies off the Asiatic coast, between lat. 16° and 58° N., extending seawards to near long. 170° E., with a small isolated area in the central part of the ocean, between lat. 45° and 50° N., and another in the upper half of the Gulf of California (as already indicated). In the Indian ocean a range exceeding 25° has been recorded off Cape Guardafui, in the Red sea, and Persian gulf.

In the southern hemisphere, a considerable area, with a range of over 25°, lies off the east coast of South America, between lat. 24° and 44° S., extending seawards off the mouth of the Rio de la Plata as far as long. 44° W., with a small isolated patch in the centre of the South Atlantic, about lat. 30° S. Another considerable area lies off the Cape of Good

Hope, extending southwards as far as lat. 46° S., and eastwards on either side of the 40th parallel as far as long. 72° E. An isolated patch occurs to the south of Tasmania, and a larger area off the Sydney coast of Australia.

Considering now those regions of the ocean where a known range of surface temperature exceeding 30° Fahr. occurs, the map shows three small areas in the southern hemisphere, one off the mouth of the Rio de la Plata, and the other two south of the Cape and Madagascar; and in the northern hemisphere two extensive areas, one in the North-West Pacific, the other in the North-West Atlantic; and smaller areas in the Mediterranean and Black sea, in the Baltic, North sea, and English channel, and at the heads of the Red sea and Persian gulf (as already indicated).

In the area off the mouth of the Rio de la Plata the greatest range shown in a single square is 33° (from 42° to 75°), the extreme range within the area being from 40° to 78° Fahr.

In the area laid down to the south of the Cape of Good Hope, the figures supplied by the Meteorological Office show a range of 29° (from 46° to 75° Fahr.) in two different squares, on either side of a square with a range of 28° (45° to 73° Fahr.), surrounded on all sides by squares with ranges of 27° and 26° Fahr., but other records from the same region indicate a range of over 30° Fahr.

In the area in the Southern Indian ocean, south of Madagascar, two adjacent squares show a recorded range of 32° Fahr. (in one case 40° to 72°, in the other 42° to 74°). The temperature within the area ranges from 36° to 74° Fahr.*

The area in the North-West Pacific with a range exceeding 30° lies off the east coast of Asia, between lat. 22° and 56° N., and the observations within the area show a range from 29·8° to 86° Fahr.

The largest area in the North Atlantic basin with a range exceeding 30° lies off the east coast of North America, between lat. 30° and 50° N.; a second area covers the greater part of the Mediterranean and Black sea; and a third small area occurs in the English channel and south-eastern part of the North sea, extending into the Baltic.

At the head of the Red sea ranges of 36° (from 57° to 93°) and of 38° (from 50° to 88°) are recorded, and at the head of the Persian gulf a range of 31° (from 65° to 96°).

A range exceeding 35° Fahr. occurs at the head of the Red Sea, in the eastern Mediterranean, in the north-western part of the Black sea, with large areas in the North-West Atlantic and the North-West Pacific, but there is apparently no region in the southern hemisphere where the records show a range as great as 35° Fahr.

* Off the east coast of Australia, near Sydney, the records show a range in one square of 28° (from 57° to 85°), and in another square of 26° (from 54° to 80°); but future observations may prove that in this locality the range is over 30°.

A range of surface temperature exceeding 40° Fahr. occurs in the north-western portions of the Atlantic and Pacific oceans, in which positions the greatest range in the surface waters of the globe is found. The observations within the North Atlantic area show a range from 26° to 83°, and within the North Pacific area from 28·8° to 88°. There are indications that in the eastern part of the Mediterranean, near the island of Cyprus, the surface waters have also a range exceeding 40°, while in the north-western part of the Black sea a similar large range occurs.

A range exceeding 45° Fahr. occurs only in the North-West Atlantic and North-West Pacific, each enclosing an area having a range of more than 50° Fahr.

A range of surface temperature exceeding 50° Fahr. is found only in the North-West Atlantic and North-West Pacific. The North Atlantic area is much the larger, extending off the North American coast, to the south of Nova Scotia, seaward to near long. 50° W. The greatest recorded range in a single square is 52° (from 28° to 80°), while the extreme range within the area is from 27° to 83°. The North Pacific area lies off the coast of Asia in the Sea of Japan, in about the same latitude as the Atlantic area (40° N.). The greatest recorded range in a single square is 52·7° (from 28·8° to 81·5°), and the extreme range within the area is from 28·8° to 83·7° Fahr.

From the foregoing discussion it will be seen that the lowest recorded temperature-reading at the surface of the sea is 26° Fahr. in the North Atlantic, eastward of Nova Scotia, and the highest reading in the open ocean is 90° Fahr., recorded in the tropical Pacific both north and south of the equator, though readings of 94° and 96° Fahr. are recorded in the Red sea and Persian gulf respectively. The greatest known range of temperature of the surface waters throughout the whole world is thus 70° Fahr. (from 26° to 96°).*

4. Relation of Range of Temperature to some other Physical Phenomena.

Range of temperature has a very important effect in bringing about a vertical circulation in ocean waters. In the equatorial regions, where there is hardly any variation of surface temperature, the warm water remains at the surface, and there relatively cold water comes nearer to the surface than in those regions in temperate zones where there is a wider daily and annual range. The cooling of the surface layers at night and during winter in temperate regions causes the salter waters of the surface to sink through the underlying layers, carrying with them heat and atmospheric gases to the greater depths. The effect of freezing

* The colours indicated on the map for the bodies of fresh water (such as the North American and Siberian lakes) have been laid down from a study of all accessible information.

in the polar regions is in the end similar to that of evaporation in warmer latitudes. The lighter ice is separated from the denser mother-liquor, which sinks to the greater depths, leaving the ice on the surface.

These statements as to the effects of range of temperature might be illustrated by reference to many parts of the ocean. It will be sufficient to refer to the most striking example, in the southern hemisphere, where there is a band of large range of temperature right round the world. The warm tropical waters, which are driven southwards along the eastern coasts of South America, Africa, and Australia, into the Great Southern Ocean, there become cooled as they flow to the east before the strong westerly winds. On account of their high salinity, these tropical waters can suffer much dilution with antarctic water, and still be denser than water from these higher latitudes at the same temperature. Here the density observations and the seawater gases indicate that a large part of the cold water found at the greater depths of the ocean probably leaves the surface, and sinks towards the bottom of the Southern Ocean, between the latitudes of 45° and 56° S.

At a depth of 100 fathoms, the temperature in one part of the ocean may differ from that to be found in some other part at the same depth by as much as 42° Fahr.; and at 500 fathoms there may be between one part and another a range of as much as 20° Fahr.; at 1000 fathoms, a range not exceeding 11° Fahr.; and at 1500 fathoms, not exceeding 8° Fahr. A consideration, however, of all the available observations shows that there is no evidence of any annual variation of temperature at any one spot in the ocean at a depth of 100 fathoms; and at a depth of 50 fathoms no annual range greater than 2° Fahr. appears to be indicated. This remark applies especially to the open ocean; but, although we have no direct observations, still it is most probable that along certain coasts a wide range of temperature is occasionally produced at the bottom in depths of 50 and even 100 fathoms, due to the lateral shifting of large bodies of water from different sources. The evidence of movements like these comes especially from regions where polar and equatorial currents meet, or run alongside of each other in different directions, as, for instance, in the case of the Gulf Stream and Labrador current off the eastern coasts of North America,* to which reference will presently be made in connection with the destruction of the tile-fish. Those areas, where currents of different temperatures meet, correspond with the areas of greatest annual range, indicated on the map by the deepest shades of blue, and they become the theatre of some remarkable phenomena, specially interesting to the biologist and geologist.

If a comparison be made between the map accompanying this paper and the maps showing the isobaric lines and prevailing winds for

* W. Libbey, Junr., "The Relations of the Gulf Stream and the Labrador Current," Report Sixth Intern. Geogr. Congress, London, 1895.

January and July, published in the 'Challenger Report' by Dr. Buchan, it will be seen that there is a general parallelism between the regions marked off by the blue colours and the position of the anticyclonic areas of the ocean. In these intermediate regions, between the equatorial band and the two circumpolar bands of small range, there is probably at all times of the year more insolation, or sunshine, and consequently a greater absence of clouds, than is to be met with in the tropical or polar areas, which may account to some extent for the wide range. It will be noticed that the deepest shades of blue are situated on the polar sides of the anticyclonic areas, and in these positions the greatest cyclonic disturbances are met with; in these regions the strength and direction of the winds and currents vary at different times of the year, owing to the position of the sun in the months of January and July. Currents from widely separated sources are in this way frequently carried over the same position even in the open ocean.

A large range of temperature, due to upwelling, as a result of the action of the winds, is indicated by the blue colours along the west coasts of Africa and South America, and on the east coast of Africa, near Cape Guardafui. The relatively wide range represented by the blue colour which extends from the Gulf of Guinea to the westwards about the equator, and a similar arrangement at the equator off the Gulf of Panama, seem to be due to currents variable in speed but constant in direction, producing greater upwelling at one season than at another, but in currents which are relatively constant in direction and speed a small range of temperature usually occurs.

It is to be noted that in the tropical regions the lines showing the variation spread outwards in the shape of a fan towards the eastern shores of the continents, whereas, on the other hand, in the northern and southern temperate regions they show a tendency to spread out in like manner towards the western shores of the continents; this is especially the case in the Atlantic. This position of the lines is what would be expected from a consideration of the general system of winds and oceanic circulation.

5. Relation of Range of Temperature to Biological Phenomena.

Where cold and warm currents meet at the surface of the ocean there is a rise of temperature for the animals of the cold current, and a fall of temperature for the animals of the warm current, which results in a plentiful destruction of organisms. The tow-net collections during the *Challenger* expedition gave frequent illustrations of this fact by the dead animals collected in such positions off the coast of North America, off the Cape of Good Hope, in the North Pacific, and elsewhere. Dr. O. Fischer records a remarkably large number of bacteria on the borders of such meeting currents. This destruction of life is not limited to minute pelagic organisms, but occasionally affects animals

which live at the bottom of the sea. Some remarkable instances of this kind have been observed between depths of 50 and 100 fathoms off the eastern coast of the United States.

Lieut.-Commander Tanner, commanding the United States Fish Commission steamer *Albatross*, reports that "on the morning of July 20, 1884, in lat. 37° 47′ N., long. 74° 15′ W., near the 100-fathom line, we passed numerous dead octopods floating on the surface. This unusual sight attracted immediate notice and no little surprise among those who knew their habits, as it was not suspected at first that they were dead. We lowered a boat and picked up three or four specimens, which we were unable to identify, but in general appearance they resembled *Alloposus mollis* (Verrill) of unusually large size. These dead cephalopods were seen frequently on the 100-fathom line and outside of it, from the position given above to the meridian of Montauk point, a distance of 180 miles. They were less numerous, however, as we went to the northward and eastward. Several dead squid were seen also, and two specimens were picked up with a scoop-net." *

A still more remarkable instance of this kind is furnished in the well-known case of the destruction of the tile-fish in the same locality in the spring of 1882.† In the months of March and April, 1882, vessels arriving at Philadelphia, New York, and Boston reported having passed large numbers of dead or dying fish scattered over an area of many miles, and from descriptions and the occasional specimens brought in, it was evident that the great majority of these were tile-fish. Naturally, these fish were not evenly distributed over all the area in which they were seen, some observers reporting them as scattering, and others as at times so numerous that there would be as many as fifty on the space of a rod square. As one account after another came in, it became apparent that a vast destruction of fish had taken place, for vessels reported having sailed for 40, 50, and 60 miles through floating fish; and, in one case, the schooner *Navarino* sailed for about 150 miles through waters dotted as far as the eye could reach with dying fishes. Computations made by Captain J. W. Collins seem to indicate that an area of from 5000 to 7500 square statute miles was so thickly covered with dead or dying fish that their numbers must have exceeded the enormous number of one billion. Since there were no signs of any disease, and no parasites found on the fish brought in for examination, their death could not have been brought about by either of these causes; and many conjectures were made as to the reason of this wholesale destruction of deep-water fishes, such as would ordinarily be unaffected by conditions prevailing at the surface, submarine volcanoes, heat, cold, and poisonous gases being

* 'Report of the Commissioner for 1884,' p. 32.

† This account is taken from Goode and Bean, 'Oceanic Ichthyology' (*Mem. Mus. Comp. Zoöl.*, vol. xxii. pp. 287, 288).

variously brought forward to account for the loss of life. Prof. Verrill has noted the occurrence of a strip of water, having a temperature of 48° to 50° Fahr., lying on the border of the Gulf Stream slope, sandwiched between the arctic current on the one hand and the cold depths of the sea on the other. During 1880 and 1881, Prof. Verrill dredged along the Gulf Stream slope, obtaining in this warm belt, as he terms it, many species of invertebrates characteristic of more southern localities. In 1882 the same species were scarce, or totally absent from places where they had previously been abundant; and this, taken in connection with the occurrence of heavy northerly gales and the presence of much inshore ice at the north, leaves little doubt that some unusual lowering of temperature in the warm belt brought immediate death to many of its inhabitants. This is the more probable, as it is a well-known fact that sudden increase of cold will bring many fish to the surface in a benumbed or dying condition, and there are no indications of any shock or earthquake having occurred at the time the dead fish were first noticed.

It has been estimated that the bottom of the ocean in this region must at the time have been covered to the depth of about six feet with the dead bodies of the tile-fish and other marine organisms, and it seems evident, from the subsequent researches of Prof. Libbey, that their destruction was due to the lateral shifting of currents from different sources and of different temperatures, thus producing a wide range of temperature even at depths of 50 and 100 fathoms.

An indirect effect of the range of temperature, and of the destruction of organisms like those above described, can be recognized in the deposits on the floor of the ocean. It is a rather remarkable circumstance that all the places where the *Challenger* discovered a great development of glauconite and phosphatic nodules in the deposits are intimately associated with a wide annual range of temperature at the surface of the ocean—as, for instance, off the eastern coasts of the United States, off the Cape of Good Hope, and off the east coasts of Australia and Japan. The *Blake* and the *Albatross* have dredged from the area where the tile-fish was destroyed, and in the Florida straits, some very large brown-coloured phosphatic nodules weighing many pounds in weight.* These concretions were made up of the remains of pelagic Foraminifera and the other materials composing the deposits, in depths of 200 and 300 fathoms, and contained 23·53 per cent. of phosphoric acid, and 52·15 per cent. of lime. In one of these nodules there were embedded two Lamna teeth, similar to those dredged in large numbers from the greater depths of the Pacific. It is, however, interesting to note that in the shark's teeth embedded in these phosphatic nodules the cartilaginous base is preserved, as in the specimens from the Tertiary deposits

* Agassiz, 'Three Cruises of the *Blake*,' vol. i. pp. 275–276 (*Bull. Mus. Comp. Zoöl.*, vol. xiv.). 1888.

and elsewhere, while in the specimens from the deep sea this base is never present; only the hard shell of dentine remains.*

The long lines of phosphatic nodules which occur, for instance, in the calcareous Miocene and Oligocene beds of the island of Malta† thus possibly indicate the occasional destruction of a large amount of animal life in the surface waters of the Tertiary ocean, owing to changes of temperature, although it might also be due to changes of salinity and other causes.

On the Agulhas bank, the *Challenger* and the *Gazelle* met with very characteristic glauconite deposits in depths between 100 and 150 fathoms, and the phosphatic nodules in these deposits were of a dark-green colour. An analysis of the *Challenger* material gave 19·96 per cent. of phosphoric acid, and 39·41 per cent. of lime; and an analysis of the *Gazelle* material gave 38·88 per cent. of phosphate of lime. In the same region the *Challenger* dredged similar nodules of a lighter colour in 1900 fathoms. It is probable that the phosphate in these nodules was ultimately derived from the fish and other animals killed at the surface, and in shallow depths, by sudden changes in the temperature conditions, this being one of the areas of wide range indicated on the accompanying map.

Still another effect produced in the deposits by sudden changes of temperature at the surface is that the deposits of Globigerina Ooze appear to be much purer beneath those areas where currents from different sources meet at the surface, especially far from coasts. This, in all probability, arises from the more abundant destruction of these pelagic Foraminifera in such situations than in other areas with a more constant temperature. The rain of the carbonate of lime shells would be more rapid and constant, and consequently they would bulk more largely in the formation of the deposit compared with the inorganic materials which are usually present. In this way there may possibly be a more rapid formation of deposits beneath areas with a large annual range than at other places.

It has already been stated that the circum-equatorial zone, with a high temperature and small range, includes the typical coral-reef regions of the world. In the tropical surface waters there is a great development of organisms which secrete carbonate of lime, such as pelagic molluscs and Foraminifera, coccospheres and rhabdospheres, and in the shallow depths around the shores organisms with massive carbonate of lime shells and skeletons are abundant, such as corals, decapod crustaceans, and a great variety of molluscs and calcareous algæ. As we proceed to the colder waters of the north and south the organisms

* Murray, "Report on the *Blake* Deposits" (*Bull. Mus. Comp. Zoöl*, vol. xii. p. 42). 1885.

† Murray, "The Maltese Islands, with Special Reference to their Geological Structure" (*Scott. Geogr. Mag.*, vol. vi. p. 449). 1890.

with massive shells gradually disappear, or are represented by small dwarfed species. In the cold polar waters the predominant animals belong to the hydroida, holothurioidea, annelida, amphipoda, isopoda, and tunicata, in which there is a feeble development of carbonate of lime.

The secretion by calcareous organisms of the practically insoluble carbonate of lime from the soluble sulphate of lime in sea-water can scarcely be regarded as wholly a direct life process, in so far as it is capable of proof that the reaction results from the decomposition of the calcium sulphate by ammonium or methylamine carbonate, secreted by these organisms in place of urea, as in the Mammalia. Of course, in lime-secreting animals the metabolism gives rise to the formation of either ammonium or methylamine carbonate, or other nitrogenous bodies which quickly decompose and yield ammonium carbonate. It is the waste or effete products of the animal itself which become the sole factor in the building up of the structures known as coral and shell. This point has been satisfactorily investigated by the experiments made by Murray and Irvine at the Granton Marine Station. With regard to the condition of the carbonate of lime so formed, it is an interesting and important fact that it is modified in an extraordinary degree by differences of temperature. For example, if, in imitation of nature, we add to sea-water neutral ammonium or methylamine carbonate in the proportion which will decompose the calcium sulphate present, and expose one portion of the mixture to a temperature of 80° Fahr., so as to represent the heat of equatorial waters, and expose another portion of the mixture to a temperature of 45° Fahr., so as to represent the cold zones of the sea, we find that in the warm water the separation of carbonate of lime begins almost at once, and takes the aragonitic form, whereas in the cold water it begins only after the lapse of a few hours, and is precipitated as well-defined rhombohedral crystals, similar to crystals of calcspar, so that in eight hours the amount of carbonate of lime thrown out of solution in the warm water is about twelve times that in the cold water. When we take into account the increased metabolism of organisms living in water at a temperature of 80° to 90° Fahr., as against the decreased metabolism of those living in colder waters, the abundant secretion of carbonate of lime which takes place in tropical waters, as compared with that in the cold waters of the arctic and antarctic regions, is readily explained. Another interesting circumstance is the greater solubility of lime and some of its salts in cold than in hot water, which fact assists in explaining the increase of calcareous deposition in warm seas over that known to take place in colder regions.*

* Murray and Irvine, "On Coral Reefs and other Carbonate of Lime Formations in Modern Seas" (*Proc. Roy. Soc. Edin.*, vol. xvii. pp. 79–109), 1890.

In those areas where the ocean is occupied by a warm current at one season, and by a cold current at another season, a periodicity can be observed in the deposition of the carbonate of lime in the shells and other calcareous structures of marine organisms, as well as in reproduction. On the other hand, in the polar and equatorial zones, where there is a small range of temperature, periodicity in the deposition of carbonate of lime, or in reproduction, is absent or difficult to recognize.

This comparative absence of massive carbonate of lime shells and corals in the polar waters, when compared with the abundance of these lime-secreting organisms in tropical waters, produces a general resemblance between the marine faunas and floras of the north polar and south polar regions, which is very striking, although this resemblance might have been anticipated from the similarity in the physical conditions, which, with reference to temperature range, is shown on the accompanying map. The resemblance here referred to in the animals of the two polar areas extends frequently to cases of specific and generic identity, the species and genera not now being found in the intermediate tropical area.

In the year 1841, Sir James Clark Ross dredged off the antarctic continent species of animals which he recognized as the same as he had been in the habit of dredging in equally high northern latitudes, and he suggested that they might have passed from one pole to the other by way of the cold water of the deep sea.

When the *Challenger* first reached the great southern ocean, the naturalists of the expedition were much struck with the general likeness of a large number of the organisms captured in the tow nets and trawls to those found on the coasts of Europe and North America. In the reports containing the detailed descriptions of species, the specialists frequently call attention to identical, or nearly identical, species from high southern and high northern latitudes, which appear to be entirely unrepresented in the intervening tropical zones. In many cases, for instance, they have been unable to detect any important differences between specimens from Kerguelen and the coasts of Great Britain, although, from purely geographical considerations, they have given a new specific name to the southern specimens.*

* Thus Stebbing describes a new species from the Southern ocean (*Amphilochus marionis*) which has a great resemblance to *Amphilochus tenuimanus* of European seas, remarking that "altogether the sum of the differences, added to the great distance between the localities at which the specimens occur, makes it unsafe to place the northern and southern examples in one and the same species" (*Zool. Chall. Exp.*, pt. 67, p. 746). Again, Smith describes a new species from the Kerguelen region (*Thracia meridionalis*), which, he says, "is the southern representative of the Greenlandic species, *Thracia truncata*, and, indeed, differs so slightly from it that it is with considerable hesitation I venture to describe it as distinct, being mainly influenced to do so by the difference of locality" (*Zool. Chall. Exp.*, pt. 35, p. 69).

Ortmann, speaking of the Decapod Crustacea, says: "Nach dem Stande unserer jetzigen Kenntniss ist *Keine einzige bipolare Art bekannt*" (Ortmann, *Zoologischen*

Dr. Günther says the most striking character in the distribution of the shore-fishes of the southern temperate zone is the reappearance of types inhabiting the corresponding latitudes of the northern hemisphere, and not found in the intervening tropical zone. This interruption of the continuity in the geographical distribution of shore-fishes is exemplified by species as well as genera; for instance, *Chimæra monstrosa*, *Galeus canis*, *Acanthias vulgaris*, *Acanthias blainvillii*, *Rhina squatina*, *Zeus faber*, *Lophius piscatorius*, *Centriscus scolopax*, *Engraulis encrasicholus*, *Clupea sprattus*, *Conger vulgaris*. Instances of genera are still more numerous: *Cestracion*, *Spinax*, *Pristiophorus*, *Raja*; *Callianthias*, *Polyprion*, *Histiopterus*, *Cantharus*, *Box*, *Girella*, *Pagellus*, *Chilodactylus*, *Sebastes*, *Aploactis*, *Agonus*, *Lepidopus*, *Cyttus*, *Psychrolutidæ*, *Notacanthus*; *Lycodes*, *Merluccius*, *Lotella*, *Phycis*, *Motella*; *Aulopus*; *Urocampus*, *Solenognathus*; *Myxine*.

Many hypotheses have been advanced to account for this bipolarity in the distribution of marine organisms, and altogether the subject is a most interesting one, which will be discussed with greater detail in another communication.

Before the reading of the paper, the PRESIDENT said: I have to welcome here again Dr. John Murray. I may as well mention that the Royal Society last week had a very important meeting, when Dr. Murray read another most interesting paper on the Importance of the Results of Antarctic Exploration, and it was followed by a discussion of great importance and considerable weight, judging from the positions of those who took part in it, and which I believe and hope will have some effect on public opinion. I am sure the meeting will also welcome very heartily the presence this evening of a gallant companion of Dr. Nansen, Lieut. Johansen. He is only here for a few days amongst us, and we are delighted to see him.

After the reading of the paper, the following discussion took place:—

Admiral Sir WM. WHARTON: I suppose the President has called upon me because I have to do with the sea; but my line of investigation is very considerably different from that of Dr. Murray. What Dr. Murray does he does very well,

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Jahrbüchern, Abth. f. Syst., etc., Bd. ix. p. 585, 1896). Henderson, in his report on the *Challenger* Anomura, in describing *Lithodes murrayi* from the Kerguelen region, says it "is apparently most closely allied to *Lithodes maia*" (from the North Atlantic), "but the latter species is of large size, and the spines on the carapace are more numerous and more uniformly equal in size" (Henderson, *Zool. Chall. Exp.*, pt. 69, p. 44). Henderson writes me that these very slight differences were the only ones he could detect, and it seems evident that had the two specimens been taken from the same haul of the trawl, or from the same locality, they would never have been erected into two distinct species. Henderson writes me further that throughout the entire range of Crustacea there is no better illustration of bipolarity than that furnished by the Lithodidæ. *See* Chun, 'Die Beziehungen zwischen dem arktischen und antarktischen Plankton.' Stuttgart: 1897. Ortmann, 'Grundzüge der marinen Tiergeographie.' Jena: 1896. Pfeffer, 'Die niedere Thierwelt des antarktischen Ufergebietes,' Die Deutschen Expeditionen und ihre Ergebnisse (Die International Polarforschung), Bd. ii. p. 455. Berlin: 1890. Murray, *Summary of Results Chall. Exp.*, p. 1459. 1894.

and he has given us a most admirable lecture to-night. He has certainly enlarged my ideas very much on the effect of the changes of temperature in the water. He has done what has not been done before—constructed this map from extreme ranges. It has been taken in some cases from a small number of observations, but probably represents the main facts. He has shown us what a great effect these changes of temperature may have on life, and he has referred also to the great effect it has on meteorological conditions—the formation of cyclones. It has been well known for a long time that the great birthplace of gales are those areas that he has pointed out, where the changes of temperature are the greatest. I am not at all prepared to follow him in his speculations as to how the animals who live in the arctic and antarctic regions have managed to change their localities; but I think he has given us very good proof that the animals are practically identical, and the question of how that has come about, I suppose, will not be solved quite yet. It is a matter for further investigation. I do not think I shall add anything to your knowledge if I say anything more.

Dr. BUCHAN: In this communication Dr. Murray has made a notable advance in oceanography. Several attempts have been previously made to show the range of the surface temperature of the ocean. But all these attempts have been simply to represent the difference in temperature between February and August, the coldest and warmest months respectively. It is, however, evident that such a range-temperature map of the surface waters of the oceans of the globe is singularly defective in showing the influence of temperature-changes on the living creatures with which the ocean everywhere teems. To do this it is altogether essential to reveal the absolute extremes of temperature to which these living creatures are exposed in the course of years. This is the problem which Dr. Murray has for years resolutely faced, and the map now hanging on the wall is the outcome of this great undertaking. It shows the difference between the absolutely highest and the absolutely lowest temperatures hitherto observed in each 2° square of the ocean, and the Royal Geographical Society is to be congratulated as being the medium of communicating this important investigation to the scientific world, which has been successfully carried out at no inconsiderable labour, time, and expense.

Mr. W. LEIGHTON JORDAN: What we have just heard from Dr. Murray evidently forms an admirable basis for a general discussion on the subject, and that has never yet been held since the *Challenger* returned, so I would suggest that the meeting be adjourned; we need not necessarily meet here, but I move that the meeting be adjourned in order that the discussion may be continued. It is too late now to have the discussion.

Dr. MURRAY: I should not be able to be present; I shall have to return to Scotland within two days.

Mr. LEIGHTON JORDAN: I am afraid it is rather late to start a discussion now—ten o'clock.

Dr. MILL: My only claim to speak is that, of all those in this audience, I am, perhaps, the one who has most enjoyed to-night's meeting. I have been associated with Dr. Murray for several years in practical oceanographical work, and it has been a wonder to me to see the way in which he has been able to fix upon those facts that were capable of the widest possible application, and to pass by others that were merely local. In his paper to-night he has brought up a wealth of material suitable for discussion, but unfortunately there are very few—in fact, I feel there is no one—fully capable of discussing this question at the present time except Dr. Murray himself. That is one of the reasons why it is so desirable that we should have some more information, such as a new oceanographical expedition

would collect. Then other people would have an opportunity of knowing something, and possibly of challenging Dr. Murray's opinions in consequence of the acquisition of fresh data.

Mr. GEORGE MURRAY: I can amply confirm the conclusion that Dr. Murray has arrived at with regard to bipolarity of organisms so far as they are concerned with the flora, both the littoral flora (those organisms that we call seaweeds) and also those that live far away from land. There is no doubt this bipolarity is especially striking in these organisms that live far away from land. Quite recently, however, with the help of Miss Barton, I made a minute examination of all the known littoral seaweeds in the arctic and antarctic regions, and we found a very high percentage of species in common; but this, however, is nothing to the community of *type* that exists among those minute organisms that live in the ocean. For example, the polar regions north and south are inhabited characteristically in the open ocean by diatoms, the temperate seas by Peridinieæ and coccospheres, and the tropics by Peridinicæ, coccospheres, rhabdospheres, and other forms. Now, I had my conclusions (which were very likely somewhat cut and dry) a little upset last summer. You know the diatoms are characteristic of the polar sea, and find their finest development there, but yet they are always more abundant near land than they are in the open ocean; in fact, by the use of a tow-net and a microscope, you would know almost as well as with a Thomson sounder when you are coming near land by the increase of the diatoms you get in your tow-net. I found in a traverse of the Atlantic that I made last summer, and from observations made for me for a whole year between the Channel and the Caribbean sea by officers of the Royal Mail Steam Packet Company—I found from those observations that there were very few diatoms as soon as we got away from land, but when we got close to Barbados we got more, and rather more again in the Caribbean sea, and when we got to Panama we got an extraordinary number. The diatoms are abundant in Colon bay from August to February, from the two extremes of temperature (there is very little range of temperature there—from 81° to 83°), and I venture to say they are quite as abundant there as they are in the arctic regions, or as they are in Loch Fyne, which, I believe, holds the record for diatoms in the number to the cubic inch, if I may put it that way. I should like to get an explanation from Dr. Murray; I should like to know whether temperature alone has much to do with this. It is quite true that in a place like Colon bay we have a very stable temperature, just as in the arctic and antarctic we have a very stable temperature. I must say the species we found in Colon bay were inseparable from the species we found in Loch Fyne. I should like to know whether the chemical constitution of the water has not something to do with this. One is rather apt to suspect this from the fact that diatoms are so abundant near land. I should like to know if these other factors have not something to do with this question of distribution, I mean besides temperature. I do not yield even to Dr. Mill in my estimate of the value of the facts brought before us by Dr. Murray; but I do plead for other factors besides temperature being taken into consideration, especially in dealing with such highly complex things as living organisms.

Dr. GREGORY: I am glad of the opportunity as a biologist of expressing gratitude to Dr. Murray for this brilliantly original and suggestive paper, for it is on the researches of physicists that the biologists must rely for the explanation of the riddles of biological distribution. There are many points in the paper, I think, that will help biologists to explain some of those difficulties. During the last few years there has been a strong tendency to attribute all deposition of carbonate of lime from the sea to the direct action of life, but Dr. Murray's experiment of the precipitation of carbonate of lime from sea-water by the addition of ammonium

carbonate may account for that inorganic precipitation of carbonate of lime which the microscope shows must take place. There were one or two points in which one could doubt whether Dr. Murray's explanations are of universal application. For example, with regard to the secretion of carbonate of lime either as calcite or as arragonite. We know that among mollusca living together on the same banks, some have shells of calcite and others of arragonite. In conclusion, I can only repeat my gratitude to Dr. Murray for this extremely suggestive paper.

Dr. MURRAY: I think that pelagic organisms which secrete silica are most abundant in those parts of the ocean where there is clayey matter in suspension, as in the arctic and antarctic seas, and in the West Pacific and off the mouths of large rivers. This, it seems to me, is more important than the temperature of the water. In discussing the causes which have led to a similarity in the fauna and flora of the two polar oceans, I may possibly have been rather speculative, and have given my imagination too much rein. The interest of the subject must be my excuse.

The PRESIDENT: I am sure we are all very glad that Dr. Murray has given his imagination a little rein, but you must also have been impressed with the enormous labour that he undertook and has completed in giving the maximum and minimum ranges of temperature of the surface of the ocean all over the world in 2° squares. It represents a great amount of labour, and from what we have heard to-night we know that it has not been labour in vain; that it has led to most interesting conclusions, and has shown the connection that exists between physical phenomena and biological phenomena, and we can have no doubt that Dr. Murray's most valuable chart will be permanently useful in the study of meteorology and of geographical distribution. I have, therefore, every confidence that the vote of thanks I now offer to Dr. Murray will be passed with acclamation.

AN EXPLORATION IN 1897 OF SOME OF THE GLACIERS OF SPITSBERGEN.*

By Sir W. MARTIN CONWAY.

LAST year (January 25) I had the honour of describing to this Society some of the results of an expedition which, in the year 1896, explored certain parts of the interior of the main island of Spitsbergen. Before that journey the interior was practically unknown. Monsieur Rabot had visited the Sassendal in 1892; and Herr Gustaf Nordenskiöld in 1890 had made the traverse over Torell glacier between two of the western bays, from Horn sound to the so-called Recherche bay of Bell sound. The result of our expedition was to show that a belt of the island bounded by Ice fjord on the north and Bell sound on the south, so far from being a region covered with ice, is practically open country, consisting of boggy hillsides and valleys, divided from one another by ranges of hills which have been carved out of a plateau. I was enabled to show, by examples, the various stages in the evolution of these hills, from their beginning in a plateau intersected by cañons to their final completion as sharp-edged, independent peaks. In no mountain region of

* Paper read at the Royal Geographical Society, March 14, 1898. Map, p. 224.

the world, known to me, can this evolution be so plainly traced as in Spitsbergen.

The expedition of 1897 was made by Mr. E. J. Garwood and myself, with the assistance of two Norwegian seamen, one of whom, Nielsen by name, was as serviceable to us as his fellow was obstructive. Our object was to investigate the interior of parts of the country believed to be covered by so-called "inland ice;" that is to say, by ice-sheets of the Greenland character. We accordingly chose two areas, to which, for convenience' sake, I have been obliged to give names. The first is the area bounded on the north by the bottom of Wijde bay and the Chydenius range of hills, on the east by the sea, on the south by Ice fjord and a line running from Temple bay across to Wiche bay, and on the west by Dickson bay; I have called this region Garwood Land, after my excellent travelling-companion. The second area is bounded by Ice fjord and Dickson bay on the east, by Foreland sound on the west. Its northern limit is approximately a line from the head of Cross bay to West fjord of Wijde bay. To this region, reviving the old English whalers' name for Spitsbergen, I have applied the designation King James Land. For the area between Ice fjord and Bell sound, explored in 1896, the name Adventure Land* is perhaps as suitable as any.

We landed at Advent bay on July 9. The little steamer that was to have met us had not arrived from Norway, so that we seemed to be stranded; but Dr. Lerner, who had taken the *Expres* for the summer, kindly offered to carry us across to Klass Billen bay. On the 10th we visited Skans bay. On the 11th, a fine day with a strong south wind, we rowed up Klaas Billen bay, little thinking that just then Andrée was ascending in his balloon from Danes gat. We landed at the foot of the Nordenskiöld glacier, dragged up our whale-boat, and pitched camp. Next day was wet; we spent it in making final preparations for an expedition up the glacier. Two sledges were loaded and dragged over a boggy and stony flat, and up a high steep moraine on to the ice. On the morning of the 13th we started up the glacier. It proved to be very much crevassed. Progress was slow and difficult. Camp was pitched about 700 feet above sea-level 3 miles inland, in the midst of a labyrinth of crevasses. On the 14th we completed the ascent of the crevassed area, and tugged on up steadily inclined snow-slopes. Fog enveloped us all the latter half of the march, and we had to steer by compass. Camp was pitched about 1500 feet above sea-level, on a little plateau at the east foot of a peak climbed by Baron de Geer in 1882. A howling storm

* In this case, as in others where new names are required, I endeavour to supply them, when possible, by reviving old names fallen into disuse or oblivion. Advent bay is a senseless abbreviation of the former name, Adventure bay. It was called Klaas Billen bay by the old Dutch whalers, but this name has been moved across Ice sound to another bay, to which it is now firmly attached.

imprisoned us in this camp for twenty-four hours. We employed the finer intervals in practising with *ski*, by aid of which the remainder of the inland journey had to be accomplished. A brief clearance enabling us to discover the best direction to take over the icy interior, we set forward again through the dense fog. Nothing was visible during the march. The snow was soft, the slope steady; the sledges travelled with difficulty. We camped again in the white wilderness. Next morning there was a short lifting of the fog, which permitted us to see westward for a few minutes, down a broad snowy valley to the line of hills that border Dickson bay on the east. The fog soon returned and blotted everything out. We marched on as before, to the north-east, with nothing visible in any direction. The slope at times steepened so much that we had to take on one sledge at a time, and then return for the other. Late in the day a howling storm burst upon us, and one of our Norwegian seamen broke down from cold, exposure, and fright. He refused to advance further, so camp had to be pitched. We were soon almost snowed under, the sledges being completely buried out of sight.

On the 18th Garwood and I left camp early in the continuing fog, and made a ski expedition to the east and north. On reaching the summit of a snowy dome, we came above the mist, and obtained a clear view to the east, where a broad glacier valley opened at our feet, leading away to the east, and then bending round south. Tributary valleys joined this one on the north. All across the north and east were plateau-fronts or bluffs of rock, with *névé* both below and above them. Garwood set forth down the valley to investigate the rocks of a nunatak; I went north up a higher snow-dome, from the summit of which I had an uninterrupted northward view. In that direction the snow-plateau continued for some distance, cut up by deep glacier valleys, beyond which were several higher mountains. Unfortunately, Wijde bay, all the hills round it, and all the region to the west of me, were buried in cloud. Late in the day we returned to camp, and found the sick man in a feeble condition. He urgently demanded to be taken back to the coast. Accordingly, we packed up camp, and set forth towards the south-east over the highest part of the snow-plateau.

The evening was most beautiful; the scenery superb. High above the clear air that surrounded us was a dark blue roof of cloud, resting on skyey walls of marvellous colours, with streaks of stratus across them, reflecting the golden sunlight. The sun itself was hidden in the north, but beneath it there hung a reticulated web, woven of gold and purple, through which the shafts of tender light drooped like eyelashes upon the snow. All around, the *névé* swept away in gentle curves and domes, greyish-white in some places with purple shadows, bluish-grey in others, here and there strewn with carpets of sunlight. The rocks, too, wherever they appeared, were rich in colour, showing their own ruddy

or orange tints enforced by the lustrous atmosphere. There was none of the sharp contrast of black and white that strikes a superficial observer in high mountain views. This panorama was a glorious mass of colour, harmonious without rift, and rich without monotony. At midnight the cloud-roof opened in the north, and a flood of sunshine poured upon us. Camp was pitched just where the slope began to dip towards the head of the Nordenskiöld glacier.

Next day, in glorious weather, we descended to the foot of a mountain, the Terrier, on the left side of the Nordenskiöld glacier, opposite De Geer's peak. We meant to ascend it next day, but were prevented by regathered clouds. Some hours were accordingly passed investigating glacial phenomena in the neighbourhood, a curious long barrel-vault of ice, and a burst glacier lake which had distributed huge masses of ice over a square mile of glacier. On the 21st we rowed down Klaas Billen bay to the Goose islands, where we spent the night. Early on the 23rd we were back in Advent bay.

On the 24th we sailed in the small steamer *Kvik*, and landed next morning at the south-east angle of King's bay. Some time was spent making observations of the great King's glacier's terminal cliff, climbing a peak in the neighbourhood, and preparing for another journey inland. We started, with two new sledges, up the south side of the King's glacier on the morning of the 27th. For the first two days the humpy and crevassed ice and the great moraines caused us infinite labour. We thus gained the King's Highway, the great south-east tributary of the King's glacier. Here were several miles of water-sodden snow to be traversed, and several broad glacier rivers to be crossed. The third march brought us to near the watershed, and on the morning of the 30th we stood on the actual pass, and could see down the whole length of the glacier we had come up, and of another glacier in the opposite direction leading down to Ice fjord, beyond whose waters Advent bay was clearly visible. For the sake of a wider panorama, we climbed to the top of a neighbouring snowy hill (Highway dome, 3000 feet). The weather was fine, and the view most comprehensive. In all directions were a countless multitude of snowy hills, with a labyrinth of *névés* and glaciers amongst them. The remainder of the day was spent in surveying, the sun being painfully hot in the clear air.

Next day we went south over a snow pass, and down on to the *névé* of the next great glacier, which we supposed would likewise flow into Ice fjord. It is a very large glacier, but it bends round south and then south-west, and empties into the head of St. John's bay. Returning by the pass at the head of this glacier, we went down the southern branch of the Highway glacier, and rejoined our old tracks after a long march.

In the angle between the two great branches of King's glacier—Highway glacier and Crowns glacier—stands the fine mountain-group of the Crowns, well known to the old navigators from their

remarkable appearance as seen from King's bay. On August 1 we climbed to the top of a pass over a spur of this group, and next day descended to the left bank of the Crowns glacier, where we encamped at the foot of a dolomite peak, named Pretender (3480 feet), on which we did a day's scrambling, whilst the men returned to the coast for stores. August 4, we moved camp over difficult glacier as far as the foot of the Middle Crown. We climbed the peak (4000 feet), and had a remarkable view, embracing the enormous *névé* of the Crowns glacier, the Cross bay mountains beyond it, the great plateau at its head, cut up into *névé* valleys (like those in Garwood Land) draining south-east towards Ekman bay. South was the irregular mountain region of King James Land. Ice fiord was clear, with the hills of Adventure Land beyond it. In the remote distance we thought that we identified the towering wall of the Hornsunds Tinder.

On the 5th we made an 18-mile *ski* expedition over the *névé*, and climbed a higher peak of the same group, the Diadem (4150 feet). The view was similar to that from the Middle Crown, but more extensive to the north. We climbed the Middle Crown again on the 6th. The 7th and 8th were spent returning down difficult glaciers to our base camp by King's bay. Throughout the whole of this inland expedition we enjoyed the most perfect weather it is possible to imagine. The four days that followed were devoted to boat expeditions in King's bay, but the weather was foggy, and little surveying could be accomplished.

On the 13th we reached and finally quitted Advent bay. We steamed down the west coast, and were dropped in Horn sound on the 14th. Here a week was spent. There was only one fine day (the 18th), on which we climbed to the highest point of Mount Hedgehog, one of the Hornsunds Tinder, though unfortunately not quite the highest point of the range. Mount Hedgehog is the peak the ascent of which was attempted in thick weather by Mr. Garwood and Mr. Trevor Battye in 1896. They reached a high point on the side of the mountain, and then were compelled to descend. Fortune was kinder to us. There was a flat floor of cloud at a level of about 1000 feet, but above that all was clear, and we enjoyed a marvellous and most instructive view, which revealed the geography of all the south part of the island. On the 21st the steamer *Lofoten* called for us on its way to Norway. Landings were made at Bear island and the North cape. Thus an interesting expedition was brought to an agreeable conclusion.

Both Garwood Land and King James Land are described on the chart as covered with "inland ice." Now, if the phrase "inland ice" merely means glaciers, so that it may be correctly applied to the glaciers of any district of snow-mountains, such as the Alps or Caucasus, it is a useless phrase, and ought to be abolished. Most persons of whom I have inquired, receive from it a different impression, and judge it to be descriptive of a complete and continuous icy mantle enveloping a

whole country, as Greenland, for instance, is enveloped. The term is used in that sense in the English edition of Nansen's 'Greenland.' "Ice-sheet" is apparently a better descriptive term for such a mantle, and I shall accordingly so employ it. The term "inland ice," being essentially vague, should, I think, be erased from geographical literature, or used only as a non-committal descriptive term to designate the ice covering some unexplored region vaguely known to be glaciated. As long as a flowing body of land-ice is contained within definite watersheds and mountain ranges, it is a glacier and not an ice-sheet. The juxtaposition of no matter how many glaciers does not form an ice-sheet, but merely a glacial area. It is necessary to be thus particular in definition because, as I shall presently show, neither Garwood Land nor King James Land, nor any large part of Spitsbergen, except New Friesland and North-East Land, is covered by an ice-sheet. They are all merely glacial and mountain areas. The discovery of this fact is the principal geographical result of our second expedition. That it is a not unimportant result I now proceed to demonstrate.

The old theory that glaciers excavate their beds to any considerable extent is practically abandoned. Its supporters naturally considered that the larger the mass of ice the more vigorous would be its excavating action. A great arctic ice-sheet was considered to be an extraordinarily powerful excavator. We now know that moving land-ice does not so operate upon its bed, but, beyond polishing the surface of the rock it covers, and cutting down convex excrescences, has mainly a conservative effect upon it. In the case of a country, like the interior of Greenland, wholly buried under ice, the buried land-surface is being modelled to a very slight degree. On the other hand, in the case of a glacial region, where mountains rise above the mean level, and where rock-faces are exposed to the rapid denudation of all snowy regions, great developments of surface-formation are going forward. Under an ice-sheet, the forces acting on the land-surface are conservative; in the case of a glacial region, the acting forces are formative. Hence the immense importance of clearly distinguishing between these two types of ice-bearing country.

In the glacial regions of Spitsbergen are many cliffs of disintegrating rock, such as the one depicted in the accompanying photograph taken by Mr. Garwood on Highway Dome, where there is *névé* or glacier both above and below the cliff. In such a case the cliff, by the action of frost and aërial denudation, continually moves backward. Its exposed face is being constantly peeled off, and the *débris*, falling upon the glacier, is not suffered to accumulate and so to protect the base of the cliff, but is carried away. The cliff thus maintains its existence, but moves continuously backwards, just as the cliff retreats over which Niagara falls.

In the accompanying diagram (Fig. 2), the glacier DE has at its head such a cliff, CD. This cliff, therefore, steadily eats its way

backward, possibly enough becoming shorter and shorter in the process. As it moves backward, the catchment area of the glacier's snow-field increases, and the glacier therefore tends to advance at its snout. If CD were the face of a sufficiently thick mountain mass, it would gradually eat its way into that mass, till the precipice had, by continuously shortening, disappeared, and the slope of the glacier reached right up to the top of the mountain mass, as in Fig. 1.

But if CD is the face of a relatively thin rock ridge (as in Fig. 2), the glacier DE will eat its way through that ridge; and if, in the valley on the other side of that ridge, there be a big glacier whose direction of flow is at right angles to that of the glacier DE, the glacier DE,

FIG. 1.—SOUTH FACE OF HIGHWAY DOME.

when it has eaten back through the ridge BCD, will carry away the upper portion of the longitudinal glacier, draining it off down its own side valley, and will establish a col between the former head and the snout of the original longitudinal glacier.

In fact, in such a case it would happen with the glacial drainage as in the Himalayas and elsewhere it has happened with the rivers. When the great Asiatic plateau was elevated, whereof Tibet now alone remains in anything approximating to the original surface condition of the whole, the drainage ran off along the hollows in the line of the crinkling of the surface coinciding with the strike of the strata. Now, however, by the operation of rivers eating their way back into the plateau at right angles to the strike of

the strata, all the great rivers flow at right angles to their original direction. The Indus was originally a stream no bigger than the Swat river, flowing down the edge of the elevated region. It ate its way through the Nanga Parbat range into the depression which goes on to Gilgit, and thus robbed all the waters of the upper Indus of to-day, which in the remote past, I believe, discharged themselves (over a high

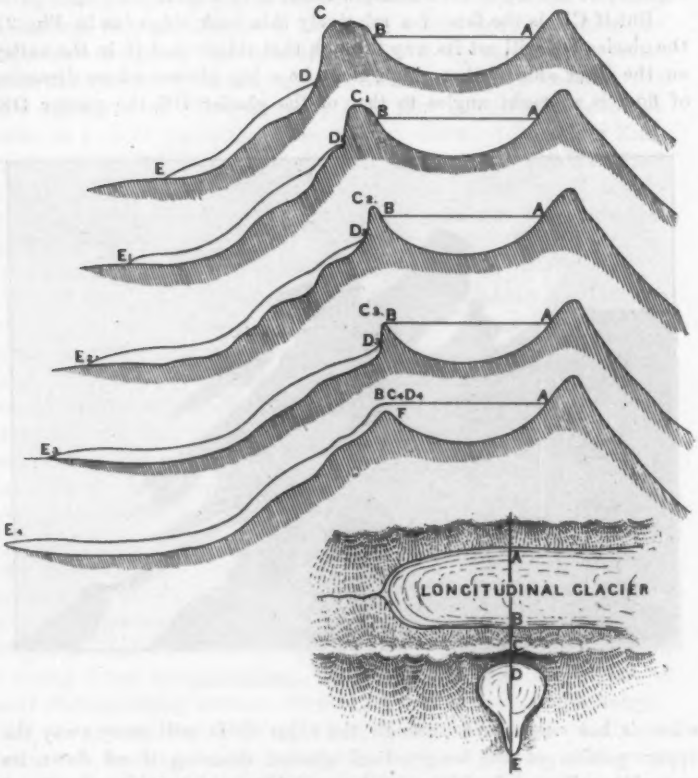

FIG. 2.—DIAGRAM ILLUSTRATIVE OF CLIFF DISINTEGRATION.

region since excavated into mountain ranges) into the Kunar river, and before that into the Oxus. Similarly, a branch of the Gilgit river has eaten back through the Rakipushi range and robbed the Hispar-Hunza river, and a branch of that has eaten back through the Boiohagurdoanas range, and is now cutting through to the Taghdumbash Pamir. It is worth notice that in each case the river has chosen the neighbourhood of the highest point of the range for its transverse gorge, not impro bably (as it seems to me) because there it had a glacier to help it as a

carrying agent in cutting through the range. In the case of rivers, this eating-back process is well recognized and understood. I suggest that it is likewise true of glaciers, though of course the phrase "eating back" is used as descriptive of the effect produced, not of the glacier's action. The "eating back" is caused by aërial denudation, not by glacial erosion; but if the glacier were not there to carry away the *débris*, the processes of aërial denudation would be arrested by the accumulation of *débris*.

The best instance I can quote of what seems a clear case of one glacier robbing the *névé* basin of another is in the Karakoram mountains. There the Biafo glacier drains a great snow-field, which appears geographically to belong to the Hispar glacier. When the incredible rapidity of denudation in those regions is remembered, it seems far from impossible that the ridge which bounds the Hispar glacier on the south extended unbroken, and not so very long ago, across the Biafo glacier, and that the gap through which the Biafo glacier now draws off the snow-field behind, is only of recent formation.

Few persons, however, are familiar with the geography of this remote region; it seems, therefore, best to illustrate the theory above propounded, by some possible example nearer home. I cite, but with diffidence, two cases from the Alps, where it seems possible that well-known glaciers may have eaten back a gap through mountain ridges. In both cases, no doubt, the eating back may have been done by water; all that I assert is that, if not done by water, it would have been accomplished by the glaciers which exist on the spot.

My first example is taken from the Mont Blanc range.* I suggest that originally there may have been a glacier with its head near the present summit of Mont Blanc, having for its left bank a ridge (or plateau-edge) now represented by the Aiguille du Midi and other aiguilles, the Aiguille Verte, the Aiguille du Chardonnet, and the Aiguilles Dorées; whilst its right bank was approximately coincident with the modern watershed as far as Mont Dolent, except between Mont Blanc de Courmayeur and the Tour Ronde, where it has been broken away. This ancient drainage system has been broken down, and now the snows of the upper reservoirs are all discharged by such glaciers as the Mer de Glace or the Glacier d'Argentière, which cut across one or other of these old containing ridges or plateau-edges.

Thus too, I suggest, the Upper and Lower Grindelwald glaciers and the Rosenlaui glacier may have invaded the Oberland plateau and crept back into the heart of the mountain mass, isolating as high individual peaks the Wetterhorn and Schreckhorn. Originally they were mere "corrie glaciers," plastered on to the north face of the plateau—just such

* Herr Imfeld's new map is the only one on which this theory can be properly examined.

glaciers, in fact, as the Guggi glacier, which lies in the hollow between the Jungfrau and the Mönch. They have crept farther back than it, because for some reason they had the better start, but the Guggi glacier now emulates their former vigorous initiative. The cliffs at its head are being continually broken and worn away by the action of frost. The rocks that fall from them either tumble on to the *névé*, and are carried down by it, or roll into the *bergschrund*, and so get under the ice, where no doubt they are ground to dust, and do some excavating in the process. That, however, can only be in the upper regions; lower down only the waters below the glacier excavate, but not the glacier itself, except, perhaps, at the edge of some subglacial cliff where an icefall is formed. In this way the rocks of the north face of the ridge between the Jungfrau and Mönch are being eaten away, and the ridge itself is not merely being lowered, but its crest is being pushed backward towards the south. Every yard of its movement is made at the expense of the Jungfrau glacier. Let the process go forward for a sufficiently long time, and the area now occupied by the upper basin of the Jungfrau glacier will be occupied by a snow-basin lying at a lower level, and draining northward down the Guggi glacier.

Similar, I suggest, may have been the development of what is now the Great Aletsch glacier. Originally, according to this theory, the Lötschen glacier stretched back to the Finsteraarhorn, and had for its left bank a ridge parallel to, but south of, the range of which the Aletschhorn is now the culminating point. The Aletsch glacier's original head was on the south face of this range, but the glacier ate its way backwards, its head advanced to the north, finally broke its way right through the range and drew off a portion of the ice of the Lötschen glacier.* The snout of the Lötschen glacier was thus disconnected from its former *névé*, and a pass (the Lötschenlücke) was formed between them. The *névé*, at what is now called the Place de la Concorde, flowed as a great icefall over the remnant of the old left bank of the original glacier. It no doubt deepened and widened the breach, and as it did so lowered the level of the snow in the upper reservoir, whose various branches were thus enabled, each in its place, to creep backwards also at the expense of the plateau. Thus were formed the Ewig Schnee Feld, the Jungfrau Firn, and the other *névé* tributaries of the present great glacier. The great icefall gradually diminished in turbulence as the cliff beneath it was broken and rounded away, till now it is merely represented by the crevassed area just below the Concordia Hut.

Whether, in fact, the processes thus suggested took place, or whether water-action forestalled the glaciers by cutting through the ridges in days anterior to the glaciation of the Alps, I am not authority to pronounce. But the position that I do maintain is this—that glaciers

* The Walliser Viescher glacier was similarly employed.

would have cut back and produced the mountain and valley forms that we see in these cases, if water did not anticipate them. That glaciers do not excavate their beds to any considerable extent is now practically admitted; but that, by acting as carrying agents, they eat back into the mountain-masses they drain, and thus perform a great function in the processes which go to the shaping of mountains, is a fact which I think has not been sufficiently emphasized. It follows that the distinction I have endeavoured to make between an ice-sheet and a congeries of glaciers is a distinction of the first importance; for under an ice-sheet none of the processes are going forward which are vigorously proceeding in a glacial region. The old idea of Spitsbergen was that its interior consisted of a great ice-sheet, fringed at the edge by a number of boggy valleys and green hillsides. Our explorations have shown the utter falsity of this conception.

Whether at one time the whole island was enveloped in an ice-sheet which was gradually withdrawn from the west towards the east, or whether the west part of the island has merely been longer raised above the sea than the east part, I do not attempt to determine. The fact, at any rate, seems to be that the forces of denudation have been longer at work, or, at any rate, more vigorously at work, all down the west part of the island, and that the resulting mountain formation is most developed in the west, and becomes continually less developed as you proceed toward the east. All down the western region you find highly specialized mountain-forms—peaks and ranges of considerable abruptness and marked individuality. As you advance eastward the mountains become generally more rounded, till the original plateau-form, and even parts of the undenuded plateau itself, are encountered.

Bearing in mind this general structure of the land-surface, it will now be easy to describe the character of different parts of the main island. The whole of the north coast, as might be expected, bears evidence of a more rigorous climate than districts further south. This was specially noticed by us when proceeding down Wijde bay, at whose mouth the snow lay down to sea-level in the month of August, whilst, 20 miles in, the snow-line was almost 1000 feet above sea-level. The northern rim, therefore, may be regarded as a separate geographical division. At the north-west angle of the island is a region of very bold mountains and large glaciers. It is well represented by the beautiful and often described Magdalena bay. Nothing is known about the interior south-east of it, but some old Dutch charts mark a valley leading from the east side of Mauritius bay up to a sequestered lake in the hills. Whether the draughtsman intended his winding valley and river to represent a glacier and the lake a snow-field, or whether a true lake and river existed here in the eighteenth century, can only be settled by an examination of the ground.

Passing southward down the west coast, we come to the seven parallel

glaciers ending in the sea, known to the whalers as the Seven Icebergs. These all appear to flow down from a high common snow-field which stretches east toward Wood bay and south almost to the head of Cross bay. South-eastward this high plateau is broken by a series of *névé*-valleys, the chief of which discharge themselves towards Ekman and Dickson bays. Their general direction is south-south-east. South of this plateau region comes the mountainous area of King James Land, whose character is shown on the accompanying map. The main watershed here runs north and south. A series of parallel glaciers drain south-south-east from it to Ice fjord. The valley system on the west is less regular, but the glaciers are equally numerous and fine.

The deep north-and-south depression filled by Wijde bay and Dickson bay is bordered on the west by a range of mountains, a group of which intrude between and divide the bays. Some of these are of striking form, but no one has ever been amongst them or accurately determined their position. East of the two bays comes the plateau region. Its edge is cut up by a few deep valleys, down which the ice-sheet of New Friesland sends glacial tongues to Wijde bay, but east of Dickson bay the marginal valleys are longer, and no glaciers come very far down them. The portion of the plateau between Dickson and Klaas Billen bays is a good deal cut up by deep valleys, such as the Rendal, the Skans valley, and the Mimesdal (all well known to geologists), but there are no large glaciers found upon it. Further east comes a great glaciated area approximating in appearance to an ice-sheet, but with many exposed faces and peaks of rock. From it several large glaciers flow into the sea, namely, the glacier that ends in the head of East fjord of Wijde bay, the glacier that fills a wide valley debouching into Hinloopen strait opposite the South Waiigat islands, some more glaciers that empty into Bismarck strait and that neighbourhood, the series of great glaciers at the head of Wybe Jans water, and the Nordenskiöld glacier (specially explored by us) near the head of Klaas Billen bay. All these glaciers are divided from one another by more or less well-marked watersheds.

The neck of Spitsbergen, which may be defined as bounded on the north by a line from the mouth of Nordenskiöld glacier to Wiche bay, and on the south by the Sassendal and the depression across to Agardh bay, is a district that would well repay exploration, and is easily accessible from the Post glacier at the head of Temple bay. Nowhere are the phenomena of mountain formation by plateau degradation under the action of rivers and glaciers better illustrated than here. In the east there are the remains of an ice-sheet; in the west there are deep and wide glacier and river valleys. Between the two are many mountain ranges, and some peaks of considerable height and abruptness.

A line drawn from the head of Van Keulen (Saardam) bay to Whales bay forms the southern limit of the next region to the south—the region that I call Adventure land. It is a country of boggy valleys, rounded

hills, and relatively small glaciers. Originally it was one large plateau, formed of soft, almost horizontally bedded rock, except along its west margin. It has therefore been penetrated by wide valleys radiating in all directions and cut down almost to sea-level. A range of rather fine peaks lies along the west coast, and behind that are some large glaciers descending north into Green harbour and south to the mouth of Low sound. Then the undulating country begins. Several valleys lead inland from Coles bay, whilst from Advent bay starts the Advent dale with its many branches. From Low sound a series of boggy valleys strike in to north and south. At the north angle of its head opens the deep valley of the Shallow river (after the Sassendal the largest valley in Spitsbergen), whose upper part has never been explored. The eastward prolongation of Low sound, which was known to the Dutch as Michiel Rinders bay, is very poorly charted, but we know that at its north angle there is a secluded inner harbour, with a big ramifying valley leading back from it, whilst at its extreme east corner three large glaciers debouch together, one of which probably connects by a high snow-field with the head of Strong glacier descending to Whales bay.

Last comes the south division of the island, over which we had a panoramic view in 1897 from the summit of Mount Hedgehog, one of the Hornsunds Tinder. Unfortunately a roof of cloud covered the glaciers, and we could only see the tops of the mountains rising clear above it. The north-west angle of this region was explored in 1897 by Mr. Victor Gatty, who found it to consist of a ring of snowy mountains surrounding the *névé* of the Fox glacier, which discharges into the so-called Recherche bay. A gap or col, south-east of Dunder bay, separates this group from a range of hills running for some distance south along the coast, and called Roebuck Land. The extremity of these hills abut against the right foot of Torell glacier, one upper bay of which rests against the hills immediately south of Recherche bay, whilst another stretches inland to the east, as far as the main watershed of the island. There are one or two other approximately north and south ranges of hills lying west of this watershed. East of it the plateau-character resumes its predominance. The southernmost part of the island, south of Horn sound, is dignified by the boldest mountain range in the country, that of the Hornsunds Tinder, which lie west of the watershed, and run almost due north and south. East of them are at least two lower parallel ranges, beyond which the ice-covered country seems to dip to the sea.

Of the other islands in the Spitsbergen group, North-East Land is the largest. It is known, from Baron Nordenskiöld's exploration, to be covered with a true ice-sheet, the edge of which descends to the sea all along the south-east coast. The north coast and the small islands off it altogether resemble the northern belt of the west island. The west belt

is a low undulating region, from which the ice-sheet has retreated in relatively recent times.

South of North-East Land are two islands, now generally known as Swedish Foreland and King Carl island. These were the "high land," discovered by Giles and Reps in 1707, when they circumnavigated North-East Land, and returned northward by way of Hinloopen strait.* It has generally been supposed that the Wiche Land of Captain Edge was the same pair of islands, but I think that this was not the case. In the years 1616 and 1617 explorations were made to the eastward of Spitsbergen on behalf of the Muscovy Company. Their results are only recorded on Thomas Edge's map, printed in Purchas, and again in Pellham's 'God's Power and Providence,' etc. (of 1631). Edge states (in Purchas) that, in 1617, a ship of sixty tons, with a crew of twenty men, "discovered to the eastward of Greenland [= Spitsbergen] as farre to the northwards as 79 degrees, and an iland which he named Wiches iland,† and divers other ilands." From the map, it is clear that both coasts of Wybe Jans water, right up to its northern extremity,‡ were explored, as well as the north-east coast of Edge Island; but that the eastern extremity of the latter was not reached, still less turned. In fact, the exploration did not extend to any part of the sea east of Edge island. A landing was certainly made on Barents island, for reindeer are marked on it. Doubtless some high point was climbed there on a clear day, and the southern mouth of Hinloopen strait was seen and the extremity of North-East Land, which is marked on the map, "Sir Thomas Smyths Iland." From the same point, no doubt, Swedish Foreland might have been seen, but, if it had been, it could not possibly have been marked as a long north and south coast-line lying between about lat. 76° and 78°, but must have been placed in or above lat. 79°. The *Wiches Lande* of Edge's map, therefore, was not seen from a hill on Barents island; nor was it seen from the sea east of Edge island. But, if seen at all, it must have been seen from some point of land or sea depicted on that map. It was not seen from a hill on Barents island; neither was it seen from the sea east of Edge island, and *à fortiori* not from the sea east of Barents island. Hence it cannot be the same as King Carl's island and Swedish Foreland. In fact, it corresponds to no existing land at all, and doubtless merely represents some bank of fog or other deceptive atmospheric phenomenon.

I have never landed in Barents or Edge islands, though I have seen both from east and from west. Neither possesses an ice-sheet. Both

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* See the great chart, "Nieuwe afteekening van het Eyland Spitsbergen op gegeven door de Commandeurs Giles en Outger Rep en in't ligt gebraght en uyt gegeven door Gerard van Keulen Boek en Zeekaart verkooper aan de Nieuwen brug met Previlegie voor 15 Jaaren."

† After Richard Wiche, a governor of the Moscovy Company.

‡ Which is in 78° 40′, but is marked by Edge as extending to about 79° 15′.

are practically devoid of glaciers down their west coast, and have large glaciers in the east. The whole of the south-east of Edge island is occupied by a great glacier ending in the sea. Barents Land has several sharply pointed peaks, but the Edge island hills are mainly flat-topped, like those along the east coast of the main island.

Prince Charles Foreland now alone remains to be considered. It is very badly represented on the existing chart. At its southern extremity is an isolated hill. Then comes a very flat plain of about 50 square miles, raised but a few feet above sea-level. Next comes a mountain range consisting of fine, sharp snow-peaks. It is cut off on the north by a deep depression, running in a south-west direction from Seehonde bay, which, though marked south of St. John's bay on the chart, lies some miles north of it. North of Seehonde bay and valley the mountain range is continued, but the peaks, though fine in form, are not so high as those of the south group, but they send down eastward an almost uninterrupted series of glaciers into Foreland sound. Further north are yet lower snowy hills, which end in the bold headland called Bird's cape or Fair Foreland.

Before the reading of the paper, the CHAIRMAN (Sir Charles Wilson, Vice-President) said: I am sorry to say that our President is confined to his house by a bad cold, and he begged me to make his excuses for not being here this evening.

Sir Martin Conway is so well known to you all, that it is quite unnecessary for me to say any words of introduction, and I will ask him at once to commence his lecture on "An Exploration in 1897 of some of the Glaciers of Spitsbergen," which I am sure will be very interesting.

After the reading of the paper, the following discussion took place:—

The CHAIRMAN: There are several gentlemen here who I think we should like to hear this evening, and I will first of all call upon Mr. Garwood, who was with Sir Martin Conway in his last expedition.

Mr. E. J. GARWOOD: In deference to the request of our Chairman, I rise to say a few words, although I am afraid the time is getting late. I must ask you to make allowance for my feelings, labouring as I am under the novel sensation of possessing, for the first time in my life, some real territory of my own. Having been told before the meeting that you might like to hear a word or two about the geological features of the country which we explored this year, I have purloined one or two of my slides from Sir Martin's box with which to illustrate the subject.

The first point to which I should like to allude is the height of the snow-line in Spitsbergen. Many of you may be under the impression that in Spitsbergen the snow-line comes down to the sea-level. Before my visit two years ago, I imagined that the typical scenery so characteristic of our own climate was totally absent from the arctic regions; that is to say, that curious denudation curve, that logarithmic curve, so characteristic of a humid climate like our own, and so well seen in the valleys of Scotland and the lake district in Cumberland. I was surprised, however, to find that in the low valleys, where unoccupied by glaciers, this was not the case. We have there true denudation curves produced even up to a height of 1200 to 1500 feet on the western coast of Spitsbergen. This is well seen in photographs of the northern slope of the Trident, in the Sassendal, where the beautiful curve and the wonderfully symmetrical gullies are evidently the work of running water acting during the short summer months.

In our explorations in the more glaciated district further to the north last summer, about which Sir Martin has told you to-night, we found scenery of a markedly different type.

Rising as they do through the inland ice system, whose surface in the interior of King James Land stands at a height of upwards of 3000 feet, the mountain ridges stand out with sharp and cleanly cut contours. These nunataks show a marked absence of the denudation curve alluded to above, and their bold and precipitous outlines are evidently the work of frost alone. This is especially apparent in the range of peaks of which the Three Crowns form the most westerly outliers (Fig. 3).

Without entering into the detailed geology of the district, it is interesting to note the influence exerted by the geological structure on scenery sculptured by frost alone. This influence is much more marked here than it is in a humid climate, where the surface features have been carved by the action of water.

FIG. 3.—THE THREE CROWNS, KING'S GLACIER.

The terminal pyramids of the Three Crowns are composed of carboniferous dolomite, lying nearly horizontally, and traversed by well-marked vertical joints. It is along these planes that the action of frost is most marked, resulting in the production of perpendicular cliffs, frequently quite inaccessible. A sharp line can, however, be drawn at the base of this formation, where it rests on the purple Devonian (Silurian ?) shales. In the latter formation, the absence of joints and the friable nature of the shales has resulted in the formation of gentle scree slopes, forming an angle of some 140° with the limestone cliff above. It is thus that we have produced the characteristic rock forms to which the name of the Three Crowns has been so aptly applied. The clean-cut diadems of golden dolomite cushioned on the purple folds of their Devonian pedestals stand like silent monuments of vanished empires.

It is always pleasant to meet old friends, and the fossils enclosed in the limestones recalled days spent on the slopes of Ingelboro', while the fish remains entombed in the Devonian shales had close affinities with the classical collections from the Old Red Sandstone of our own islands.

Here and there, as at the base of the Pretender, rise islets of an earlier age, lifting their heads through their icy covering, and I am proud to state that my patrimony to the East also dates from these Archæan times.

FIG. 4.—THE SUMMIT OF THE KING'S HIGHWAY.

FIG. 5.—HIGHWAY DOME, KING JAMES LAND.

The position of these carboniferous rocks to the north of Highway glacier requires a word of explanation. Their occurrence here appears to be due to a vast

dislocation or thrust running south-west from King's bay, which has brought up the older schists on the south side, and let down the whole of the carboniferous area

FIG. 6.—KING'S GLACIER AND BAY.

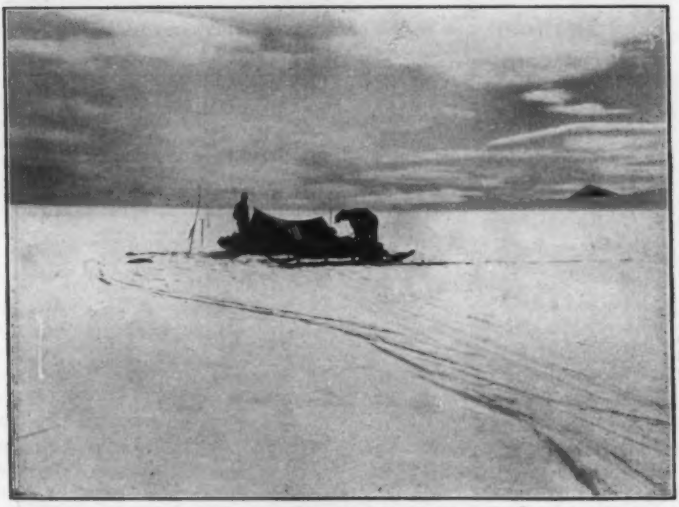

FIG. 7.—THE LAST CAMP NEAR MOUNT CHEIDENIUS.

on the north, for we find patches of carboniferous rocks let in against the schists on the south side of Highway pass. The disturbance curves somewhat on the south

shore of King's bay, causing the carboniferous beds to be tilted on end, and run as a broken ridge across the entrance of Ice fjord and Bell sound, in which latter bay the ridge forms the interesting little Axel island.

I would call your attention to some novel and somewhat interesting structures which we met with this year. They occurred both on the ice of Nordenskiöld glacier, and also on the King's glacier at the foot of the Pretender. They consisted of long arched tunnels running in parallel rows on the surface of the ice, and rising from 3 to 8 feet in height above the general level of the glacier. When we first saw these tunnels on Nordenskiöld glacier, we were inclined to attribute them to surface streams frozen in winter and arched by expansion into their present forms, but after a careful examination of those at the foot of the Pretender, I have come to the conclusion that they result from the snow bridges which here, as in Switzerland, span the crevassed portions of the ice, but which here, owing to the rapid melting and intense frosts, are converted into ice. On reaching smoother and more

FIG. 8.—NORDENSKIÖLD GLACIER CAMP.

level reaches of the valley, the walls of the crevasses close up, and the bridges are thus forced up into these arched tunnels by lateral compression.

An interesting result of river-action which we came across this year on the ice consisted of horizontal tunnels excavated, not on the surface of the glacier, but in the heart of the ice. One of these, which occurs on the left bank of Highway glacier, had a diameter of 12 to 15 feet, and was nearly circular in section. It was evidently produced by the discharge of a lake which formed between the ice and mountain range to the south, along the line of the thrust-plane described above. This lake would be dammed up every spring by the winter snow, but in summer it would empty itself almost instantaneously as soon as the barrier was broken through. In rushing through the ice-tunnel it carried with it innumerable fragments of rock, which it deposited all over the floor of its channel. This channel ran at right angles to the direction of Highway glacier, and we have here an instance of one possible origin of the gravelly ridges known in our own country as *kames*

and *eskers*; for on the retreat of the ice now occupying Highway valley, this material will be deposited on the floor of the valley, forming a ridge of gravel containing glaciated and water-worn fragments running at right angles to the final drainage-line of the district.

If we examine photographs taken from Mount Nielson, and looking south-east across the island, it will be seen how little was known of the interior previous to our visit; for instead of the "High inland ice" which appears written across the chart at this place, we find, as shown by the photographs, ranges of mountains stretching across the island to North fiord (Figs. 4 and 5).

I cannot resume my seat without attempting to bring home to you something of the beauty and delicacy of the colouring, which is such a characteristic feature of midnight scenery on the coast (Figs. 6 and 7). The photograph (Fig. 6) was taken about 1 a.m., while cruising along the shore of King's bay, threading our way in the whale-boats through the countless icebergs broken off from the front of the King's glacier.

Prof. BONNEY: I am not going to say a word about Spitsbergen, because I am one of those most unfortunate people who have not seen it. I shall only venture a remark or two on a comparison which my friend Sir Martin Conway made between Spitsbergen and the Alps. I very much doubt whether it is possible to explain the general structure of the higher valleys in the Alps as he has done by reference to Spitsbergen. It seems to me that you cannot make any comparison between a district comparatively narrow in regard to its height with one like Spitsbergen, which is carved out of a kind of plateau. And, in addition to that, I may say that the present Alpine valleys seem to me to follow the ordinary lines of denudation, and resemble valleys that have been excavated by water in most parts of the world. But the fact is that so much sculpture work has been done on the Alps since the time they first began to rise that it is almost impossible to conjecture what their original structure was. I think that slight resemblance which he detects in one or two places to a plateau country, is the effect of the two disturbances the central Alps underwent while they were assuming their present form. In that district the great disturbances of the second elevation were concentrated on the northern side, and this no doubt had the effect of throwing that range rather abnormally high, giving a sort of trough between it and an outer range, which may at one time have been the actual crest of the ridge. But I do not think it possible that we can regard the lower Aletsch glacier as made by a small glacier eating back into the main upland valley which once, he presumed, drained towards the Rhone. Because of this—the structure of the Alpine valleys is certainly preglacial; that you can see in every part. You may notice it in the Pontresina district, and in the Val Bedretto. You can see in those very hard rocks that the glaciers have been down in that narrow V-shaped valley almost in the water's edge. Well, in addition to that, when you come to look at the cirques in the limestone districts, one cannot see how those can have been eaten back very appreciably if their beds were filled with *névé*, and further, it is evident from the way they are connected with the valleys, that if the valleys themselves were occupied down to their present beds by ice, so too the beds of the cirques must be occupied. But it may be said, perhaps, there were glaciers before the days of the great ice-age. No doubt, but still, were they glaciers of much importance? When the Alps were first upheaved, the temperature of Switzerland must have been at least 16° higher than it is at present. The effect of that would be to change the position of the snow-line, and, assuming the Alps to be at their present elevation, if the mean temperature were 16° higher than it is at present, you would practically have no glaciers at all, because the snow-line would be about 13,000 feet. With

that it would be impossible to talk of this cutting. No doubt the temperature fell steadily to the ice-age, but my point is that, putting the two things together, namely, the valleys having existed before the ice, and the improbability of there having been any great masses of ice, it is very improbable that material changes, such as the tapping of that upland valley by ice now forming the lower portion of the Aletsch glacier, ever would have occurred. I think, therefore, my friend Sir Martin Conway has really tried to stretch a truth to rather more than it will bear. He has, no doubt, spoken of what is a true cause in modifying the heads of glaciers, but I do think we cannot call it more than a secondary cause, and, at any rate, whatever may be its effect in Spitsbergen—and I cannot say anything about that, because I have not been there—I do not think it has produced any material effect in modifying the structure of the Alps.

Mr. Marr: I have, in the first place, to thank the lecturer for his very able and interesting paper. Geologists are apt to state that geology is the geography of past times. Of course, you may at once retort that shows geologists are geographers not up to date. As it is rather late, I want to refer to one thing only, and that is that very charming diagram which Sir Martin Conway showed on the screen, the diagram where the glacier extended up the hillside, and was gradually robbing a larger glacier; the tear-drop extended until at last the whole of the hillside seemed to dissolve in tears. I would suggest, from a geological point of view, the robbery would have been better without the extension of the tears, for I believe that, although the glacier is largely responsible for draining off one valley system into another, the process is not due to the upper extension of the glacier, but to the action of the weather on the solid rock. The glacier is simply responsible for clearing away the *débris* which the weather has brought down, so that I fancy Sir Martin would make his case better if he did not put that upward extension in.

Sir Erasmus Ommanney: As an old arctic navigator, I wish to express my admiration of what has been accomplished by this expedition. We are extremely indebted, I am sure, to Sir Martin Conway for striking out a new line of exploration in the arctic regions. Whatever we have done hitherto has been by coast navigation; he has had the courage to undertake the inland exploration, and to bring before us the physical features of the interior of Spitsbergen. Sir Martin Conway's experience as an alpine traveller has been able to provide us with the information he has brought us to-night. I believe that we have rarely had a traveller who has brought before us so vividly and so graphically all that he has seen. He has derived a vast amount of glacier information with such a very small party, from the highest elevations as yet attained in Spitsbergen.

Dr. J. W. Gregory: I have listened to the paper to-night with very great pleasure. It was my privilege two years ago to accompany Sir Martin Conway on the expedition to which the one just described was the sequel. Of the country which has been so graphically described by Sir Martin Conway, and which has been so beautifully illustrated by Mr. Garwood's lovely photographs, we caught occasional glimpses in 1896; in that year, as in 1897, the district appeared to be always bathed in sunshine, which was very tantalizing to us then, as we were nearly always wrapped in fogs. But last year Sir Martin Conway and Mr. Garwood had the benefit of the sunshine, and we have had the benefit of it to-night in the photographs which it enabled them to take. In regard to the geological theory in Sir Martin Conway's paper, I agree with the views expressed by Prof. Bonney, and I feel considerable doubt as to how far the agency invoked has been a valuable factor. No doubt it is a true cause, and must have some influence, but the question is whether it is the secondary or the primary cause of changes. The Alpine valley system in the main dates from pre-glacial times, and it is almost impossible

to ascertain how far the system has been modified by post-glacial changes. I heartily congratulate Sir Martin Conway and Mr. Garwood on their perseverance in returning to the country, and on the valuable results they have brought back.

Sir Henry Howorth, M.P.: I have little to say except to emphasize what has been said so well already. I should like to add, however, that, being a member of Parliament, I have been delighted at the number of graceful adjectives these gentlemen have at command. In regard to the theoretical part of the issue raised by my friend Prof. Bonney and my friend Sir Martin Conway, there is this advantage—that what they have had to put forward is at all events consistent with the laws of physics and with the laws of ice-movement. Occasionally we have had to deal with some terrible theories which have been consistent with neither. The first paper I ever read in my life was when I was seventeen, when I read a paper before this Society on the areas of land that are rising round the two poles, which I mapped out and showed to be fairly continuous. One of the interesting points about Spitsbergen is this—that the evidence shows plainly that very recently the Spitsbergen archipelago has risen from the sea to a very considerable extent, and in that way its climate has been altered very much for the worse. Baron Nordenskiöld showed me some wonderful post-Tertiary shells he had found in Spitsbergen, and pointed out that those shells are not found in Spitsbergen now, but prevail in Southern Norway. This is another strong proof of the same fact. Just as the case of Greenland, where we have the same recent change in climate attested by the fact of the land having risen in the first place, and secondly by the occurrence of similar shells. Possibly the most arctic conditions that ever existed in these islands are not in periods that have gone by long ago, but in the current period; and that while we were suffering from tremendous glaciers in the old days, it would appear—and that is the view of more than one recent Danish explorer in Greenland—that the climate and the temperature were very much more moderate than they are at present in these high latitudes. I must, in conclusion, again repeat how delighted we have all been, both at the graceful discourse and the photographs, and I would say, that if ever I travel in these regions, there is no person other than my wife with whom I would rather travel than with one or other of these two graceful persons.

The Chairman: I think, at this late hour of the evening, it is almost time to close the meeting. I therefore ask you to allow me to return thanks to Sir Martin Conway for his eloquent lecture. We must all admire the way in which he attacked Spitsbergen, and he has brought the results of his journey before us in a very pleasant manner. I hope you will allow me to include in the vote of thanks Mr. Garwood, whose photographs have given us better pictures of the country than we have ever seen before; in fact, I think they are amongst the best photographs of arctic scenery that I have ever seen at the Society's lectures.

MR. FRAZER'S PAUSANIAS.*

By the Rev. H. F. TOZER.

A new edition of Pausanias' 'Description of Greece,' in which that work should be illustrated by the light which modern discovery has thrown on the subjects with which it deals, has long been a *desideratum* among

* Pausanias' 'Description of Greece.' Translated with a commentary, by J. G. Frazer. In six volumes. London: Macmillan & Co. 1898.

scholars and classical archæologists, but the greatness of the task has hitherto discouraged the boldest spirits from attempting it. For Pausanias' book is in its way unique in literature. Nowhere else can we find so complete an account of an ancient country, especially in respect of the buildings and works of art which it contained. And the period at which it was composed was eminently suitable for such a task, for at no time, in all probability, had the monuments of Greece been so numerous and in so good preservation as they were in the middle of the second century of our era when Pausanias wrote. In places, indeed, decay had then already begun, but this was compensated by the work of restoration which shortly before that date had been promoted by the Emperor Hadrian. But, in addition to remarkable industry in observing these objects, and carefulness in noting down their details, Pausanias was possessed by an extraordinary curiosity concerning the legends and superstitious beliefs which were attached both to the sacred relics preserved in the temples and to natural features of the ground, such as fountains and groves; and stories connected with these are of constant occurrence in his narrative. Now, in respect of both the subjects by which the old archæologist was thus attracted, an extraordinary advance in knowledge has been made during the last half-century. This has been pre-eminently the age of excavation in Greece, so that, in the course of it, one after another of the most famous ancient sites in that country have been exposed to view, and it has thus been possible to verify the statements of Pausanias on the spot, through the discovery of the buildings and statues which he saw, or of inscriptions relating to them. Again, during this period there has been a remarkable development of the study of folklore, and of the branches of anthropology which are akin to it; so that in numerous instances the portents and marvellous stories which Pausanias records can be paralleled by tales and customs which have been discovered in distant parts of the world, and, instead of being regarded as mere curiosities, can, to some extent, be classified. It is clear that the competent editor of Pausanias should be one who is well versed in both the studies which have just been mentioned.

Such an editor has been found in Mr. Frazer, and the six handsome volumes which compose the present edition furnish ample evidence of his competency for the task. The first of these contains Mr. Frazer's introduction, and his translation of Pausanias' work, by means of which it is brought within the reach of other than classical students; and with the same object in view Mr. Frazer has avoided the use of technical phraseology in his notes, as far as is compatible with a scientific treatment of his subject. The English of the translation is clear and good, and, when the style of Pausanias admits of it—as, for instance, in the history of the Messenian wars—it rises to more than average excellence. The last volume comprises the two indexes, the larger of which, a very

complete one, is devoted to the work itself, the smaller to the notes. The four intermediate volumes contain Mr. Frazer's commentary, which is his most important contribution to the subject. In this the statements of Pausanias are throughout made the starting-points for discussions of theories and for the introduction of fresh information; but to describe it as a body of notes explanatory of that author would give an entirely erroneous view of its contents, especially as regards its archæological side. In reality, it contains a full account of the discoveries that have been made in Greece up to the present time, together with summaries of the views which have been held concerning the identification of localities and buildings and works of art. The labour which this task represents is enormous, and its value to the student is correspondingly great, because the material from which the information is drawn is largely to be found in foreign periodicals and books in various languages, many of which are not easily accessible. Mr. Frazer has also shown great penetration and a well-balanced judgment in deciding between the conflicting opinions, to which, as might be expected, these discoveries have given birth. In addition to this, he has himself travelled extensively in Greece, and has described a large number of the most important sites from his own observation; by which means the notices of the localities mentioned are rendered more lifelike, and the severity of the scientific treatment of the subject is modified by the introduction of personal impressions. Mr. Frazer's learning is not less conspicuous in those parts of his commentary which deal with folk-lore, a study with which he had previously shown himself thoroughly conversant in his book, 'The Golden Bough.'

It is no easy matter to give the reader even an approximate idea of the contents of a work of such magnitude as this; it must suffice, by way of illustration, to mention a few instances of what is to be found in it under various heads. As might be expected, the largest amount of space has been devoted to those places where excavations have been carried out on the greatest scale. Thus to Olympia, the ruins of which were laid bare at the expense of the German Government, 153 pages are allotted; and this allowance does not appear excessive, when we consider that Pausanias devoted the greater part of two out of his ten books to that place. It includes also Prof. Treu's restorations of the gables of the temple of Zeus, and Mr. Stuart Jones's conjectural reproduction of the chest of Cypselus from Pausanias' description. To Delphi, the scene of the latest operations of the French School of Athens, 151 pages are assigned; and in this part will be found an account of the serpent column that supported the tripod commemorative of the battle of Platæa, which was dedicated at Delphi, but was removed thence by Constantine the Great to Constantinople, where the column is still standing in the Atmeidan, or hippodrome. In like manner, the work of the British School at Megalopolis, that of the American School

at the Heræum of Argos, and that of the Greek Archæological Society at Eleusis, and at the Hieron of Epidaurus, receive their due share of attention. Mycenæ, too, is well described, and the important questions connected with it—the date and origin of the Mycenæan civilization, the relation which it bore to that which is described in the Homeric poems, and the race to which the Mycenæan people belonged—are discussed with excellent judgment. Mr. Frazer's opinion is that the Mycenæan art was of native development on the shores of the Ægean, though certain elements in it came from Egypt and Syria; that the forms of that civilization which are found in Crete represent an earlier, the Argolic forms a later, stage in its development; and that the Homeric period was somewhat posterior to that which is represented at Mycenæ.

As regards the geographical features of Greece, perhaps the most important notices which are met with in this work are those which treat of the underground passages, which form the only outlets of the water that collects in many of the inland valleys of that country. The most remarkable instance of this phenomenon is found in the basin of the Copaic lake, and this is especially interesting at the present time, because that piece of water has quite recently been drained by the construction of artificial passages to carry off its waters, and the area which it previously covered is now a cultivable plain. Mr. Frazer has given us an account, mainly derived from his own observation, both of the modern system of drainage by which this change has been effected, and of similar attempts which were made in antiquity, for of these latter conspicuous traces remain. The corresponding features which are found in the lakes of Pheneus and Stymphalus in Arcadia, and the periodical disappearances of those pieces of water arising from the opening of the subterranean passages which drain them, are also interestingly described. An equal tribute of praise must be given to the discussions of the arguments relating to certain localities which are disputed at the present day. Conspicuous among these is the question of the position of the fountain of Enneacrunus at Athens. Pausanias' description of this has long been a standing puzzle, for he evidently conceived of it as lying in the valley between the hills of the Pnyx and the Areopagus; and Dr. Dörpfeld, who has recently excavated this neighbourhood, has with great, though somewhat over-subtle, ingenuity maintained the correctness of this view. Mr. Frazer, however, is so strongly impressed with the waterless character of this site, and with the almost unanimous testimony of ancient writers in favour of the traditional position of that fountain in the neighbourhood of the bed of the Ilissus, that he decides unhesitatingly against his author and his modern champion. In respect of another disputed point in Athenian topography—the position of the river Eridanus—Mr. Frazer is at one with Dr. Dörpfeld. This stream has usually been identified with the one which rises at the monastery of Kæsariani, on the side of Mount Hymettus, and joins the Ilissus on

its left bank, and this view was still maintained by Ernst Curtius in his latest work, 'Stadtgeschichte von Athen' (1891). But Dr. Dörpfeld, relying on the statements of ancient writers concerning the objects which are in its neighbourhood, and especially on the remark of Callimachus, that in his time its water was so foul that cattle would not drink of it, concludes that the Eridanus flowed from the south-western slopes of Mount Lycabettus, and passed through the northern part of Athens, in doing which it would easily be converted into a public sewer; and these arguments appear to Mr. Frazer to be conclusive.

The maps and plans which accompany these volumes are of great service in elucidating the text, and the numerous illustrations will be invaluable to students of Greek sculpture. Altogether, Mr. Frazer is to be congratulated on having produced a monumental work, which is a storehouse of learning and research.

PROPOSAL FOR AN EXPEDITION TO SANNIKOFF LAND.

By Baron E. von TOLL.

On the oldest map of the New Siberia islands, dating from the year 1811, the outlines of two lands are marked, and they bear the inscription, "Land sighted by Sannikoff." One of these stretches on the map from the meridian of the northern point of the Fadeyev island to the longitude of the "High Cape" of the New Siberia island, while the other is marked in the north-west of the island Kotelnyi.

Jacob Sannikoff was a Yakutsk merchant,* who undertook a series of bold journeys to the New Siberia islands from 1805 to 1811, and was first a *promyshlennik* (hunter) in the service of Syrovatski, who had then the monopoly of exploitation of mammoth-tusks in the Liakhov islands; later on he accompanied Mathias Hedenström in his journeys. Sannikoff was one of the discoverers of the New Siberia islands, and we are indebted to him for some very important information concerning the peculiar nature of the islands, which information was transmitted to the world through Hedenström's writings. The first, although unsatisfactory, topographical survey of the islands was made by the topographer Pahenitsyn. Sannikoff was also the first to spend a full summer on the northern island of the New Siberia archipelago. During that stay, he had the opportunity of sighting with his sharp eyes, on clear summer days, those two lands situated the north of the islands, Kotelnyi, Fadeyev and New Siberia, and their supposed outlines were marked on the above-mentioned map according to his indications. His and Hedenström's attempts to reach those lands in sledges drawn by dogs were, however, unsuccessful, because open spaces amidst the ice (*polynias*) soon compelled both explorers to return.

Ten years after the completion of the Hedenström and Sannikoff's journeys, the Imperial Russian Ministry of the Navy sent out the well-known expedition of Lieut. Anjou, which had to settle the topography of the New Siberia Islands, as well as the question relative to the existence of the lands sighted by Sannikoff. After two unsuccessful attempts, made in 1821 and 1822, to overcome with dog-sledges the obstacles offered by the *torosses* (ice-heaps) and *polynias*, Lieut. Anjou declared, in a report addressed to the authorities in 1822, that he was ready to renew the attempt in a boat, starting from the island Kotelnyi, or Fadeyev, but

* More correctly a burger (*myeschanin*) of Zyryan origin, as his descendants said.

that it was impossible to attain those lands in dog-sledges. However, his proposal was not accepted, on account of the considerable danger which it offered, and Anjou returned in 1823, after having made his last sledge-journey along the coasts of the New Siberia Islands, with the full conviction that, "within the distance which could be attained with the means at hand, there was no land in the north of the islands, Kotelnyi, Fadeyev, and New Siberia."

On the authority of Anjou, the "lands sighted by Sannikoff" disappeared from the maps, until full sixty years later, *i.e.* in 1881, the tragical expedition of De Long confirmed, by the discovery of Bennet Land, the existence of the land sighted by Sannikoff from the "High Cape" of New Siberia. This discovery gave support to the idea that the other land, which Sannikoff saw from the Kotelnyi island, but of the existence of which Anjou was doubtful, was not merely an optical mistake, and consequently a dotted shore-line reappeared on the maps, with the name of "Sannikoff Land." *

In the mean time, the tradition about the existence of the land that Sannikoff saw in the north of Kotelnyi island was maintained amidst the *promyshlenniki* (hunters), because those of them who had visited the Kotelnyi island confirmed Sannikoff's statements. In reality, I could convince myself of the exactitude of this affirmation in 1886, during the expedition which was sent out by the Imperial Academy of Sciences, under the leadership of Dr. A. Bunge. On August 13th I saw, during quite clear weather, from the mouth of the Mogur river ("Sannikoff river" on Anjou's map), under 79° N. lat. and 139° E. long., in the direction N. 14° to 18° E.,† the sharp outlines of four truncated cones like table mountains, from which a low foreland extended towards the east. At that time I had no possibility of making an attempt to reach that land. A solid ice-crust seemed to stretch from Kotelnyi island to Sannikoff Land. Perhaps the *polynia* was at that time closed by floating ice, or it opens only during the cold season and after strong storms. At any rate, in order to cover the distance of about 200 kilometres (130 miles) to Sannikoff Land, both dog-sledges and a good boat would have been required, while I had at my disposal only ten worn-out reindeer, with which I had undertaken to make the round of the island. I was bound to return southwards to my headquarters, the winter hut at Uranalakh, where my dogs recovered their forces for the return journey to the mainland. True that a boat had been made there in the mean time out of driftwood, with the aid of a keel and ribs which had been brought from the mainland. But, "uneven-bowed and leaky" as that boat was, it could only be used on August 23 to 25 for a few trips along the coast amidst the ice-floes; it was impossible then to think of a dash towards Sannikoff Land.

In the year 1893 I once more put my foot on the Kotelnyi island, during a rapidly organized excursion, which lasted from May 2 to June 8, and which I made on dog-sledges, but having no boat with me. My main working field was at that time further west, on the Anábar. While I was there, in August and September, the *Fram* sailed along the coast of Siberia towards the New Siberia islands, and passed by Sannikoff Land. Fridtjof Nansen's diary has, under the date of September 20,

* This was done, first, at the proposal made by A. Grigoriev, in his paper, "Sannikoff Land," in connection with the discovery of the expedition of the *Jeannette* (*Izvestia* of the Russian Geogr. Soc., vol. xviii. (1882), fasc. 4, pp. 264-267); also Fr. Schmidt, "Remarks concerning Nordenskjöld's 'Circumnavigation of Asia on board the *Vega*,'" in *Beiträge zur Kenntniss des Russischen Reiches*, II. series, vol. vi. (1883), pp. 355-356.

† Anjou determined the position of the mouth of Sannikoff river as 76° 2′ 3″ and 136° 33′ E. of Paris. His magnetical constants are 16° 40′ E. and 82° 57·7′. Consequently, the mountains of Sannikoff Land ought to have been marked on the map due north of the northern extremity of Kotelnyi island.

the following inscription: "We now held (in lat. 77° 44′ N.) north-west along the edge of the ice. It seemed to me as if there might be land at no great distance; we saw a remarkable number of birds of various kinds. A flock of snipes or wading birds met us, followed us for a time, and then took their way south. They were probably on their passage from some land to the north of us. We could see nothing, as the fog lay persistently over the ice. Again, later, we saw flocks of small snipe, indicating the possible proximity of land. Next day the weather was clearer, but still there was no land in sight. We were now a good way north of the spot where Baron von Toll has mapped the south coast of Sannikoff Land, but in about the same longitude. So it is probably only a small island, and in any case cannot extend far north" ('Farthest North,' I. p. 203).

It appears to me, from Nansen's words, that in his opinion the *Fram* was on that day on the north of Sannikoff Land, and that the birds which he saw were returning from some other unknown land. I believe, however, that the flocks of snipes must have been flying from Sannikoff Land, and that the *Fram* probably was at that moment south of that land. I myself am, to some extent, the cause of that mistake—if mistake there is—because Nansen based himself on my preliminary sketch-map, upon which I had roughly traced the southern extremity of Sannikoff Land in the year 1887. I think, however, for reasons which will be better understood from the following, that in reality Sannikoff Land is situated further north than where I had traced it on the said sketch-map. If it be so, the considerations which made Nansen conclude that that land is but a small island are removed.

The mountains of Sannikoff Land, which I saw through the telescope, very much reminded me by their shapes of the basalt cones of the Svyatoi Nos, as they appear to the eye from the southern shore of the great Liakhov island. The forms of the mountains of the Sannikoff Land thus authorize us to believe that these mountains consist of basalts, like the mountains of Bennet island, the southern point of which (Cape Emma) is said to consist of the same rock, according to the diary of De Long. As to the distance between Sannikoff Land and the Kotelnyi island, we may estimate it as follows:—

When we take into account that the height of the trap, or basalt mountains, in Arctic Siberia altogether is subject to but small oscillations, and, at any rate, seldom exceeds 1200 feet, and that the mountains of the Svyatoi Nos, looked at from the south coast of the Liakhov island, at a distance of about 45 miles, appear to be twice or thrice as high as the mountains of Sannikoff Land, we may conclude that the distance between Kotelnyi and Sannikoff Land is twice or thrice as great as the above—that is, from 100 to 125 miles, or from $1\frac{1}{2}$ to 2 degrees. I conclude, accordingly, that the south coast of Sannikoff Land must be located under about the 78th degree of northern latitude.

As to the probable extension of Sannikoff Land, and the question whether there are to be expected other islands besides those which have been discovered by De Long,—the Bennet, Henrietta, and Jeannette islands—we have, in my opinion, some established points, which permit us to express, with due caution, the following suppositions:—

1. It must be remembered that the traps, which have a wide extension in Siberia, always appear in massives not far apart from each other. Their distribution answers to certain tectonic lines, along which they pierce the sedimentary rocks, whether the latter, being horizontal, build up plateaus, or whether they take the shape of folded series of parallel ridges. The trap mountains are volcanic mantles which spread over the sedimentary deposits; occasionally they have maintained the forms of volcanoes with well-determined craters. Bennet island seems also

to contain, besides the basalts, beds of lignite, which may be considered with great probability as a continuation of the tertiary lignite beds of New Siberia which appear under the same longitude, and are known as the "Wood mountains." The similarity of structure between New Siberia and Bennet island is thus evident, and it is permissible to suppose that Sannikoff Land and Bennet island represent only parts of a trap region having a certain extension.

2. De Long found on Bennet island the antlers of a reindeer, about which he was not certain whether they belonged to a recent or to a fossil individual. In the first case, we could admit either that Bennet island has such a climate as permits reindeer to sojourn there—which would naturally seem highly improbable—or we should be bound to admit that the antlers belonged to an animal which came from New Siberia, and would have been killed in the island, which also seems to me a rather forced explanation. But if these antlers were fossil, then the other contemporaries of the reindeer, the mammoth, the rhinoceros, the musk-ox, etc., whose remains are so characteristic of the New Siberia islands, must also have lived in Bennet island. We should then expect to find in Bennet island and Sannikoff Land the same geological features as in New Siberia. Further, we should then have to conclude that the coast-line of the Post-pliocene Siberian continent not only included the New Siberia islands—which has been firmly established by the two last expeditions of the Academy of Science—but that this old coast-line must be traced still further northwards. How far this old continent—which, like New Siberia, is now broken into an archipelago—stretched northwards, and whether it ended at the spot where Nansen found, in 79° N. lat. and 140° E. long., a depth of 1050 feet, or whether it stretched further to the north and the north-east of the course of the *Fram*, is precisely a most interesting geographical question.

3. One of the results of Nansen's *Fram* expedition is the highly important fact that the drift of the *Fram* was not a continuation of the drift of the *Jeannette*, but, although both had the same origin, the latter was to the north of the former.* What is there producing this bifurcation of the current? I cannot answer this question otherwise than by the supposition that there are lands lying in the north of the New Siberia islands, which lands need not stretch, of course, as far as the pole, but must have a sufficient size to produce the said bifurcation of the current.

4. In the drift course of the *Fram*, as well as along the route followed by Nansen and Johansen, it appeared that floating ice always drifted with a greater facility northwards, while it was mostly blocked when it was pushed south-eastwards—that is, in the direction of the archipelago which I suspect to exist.

If these considerations relative to the probable extension of Sannikoff Land and its belonging to an undiscovered archipelago be true, the whole matter is, of course, only about such masses of land as may have the size of Franz Josef's Land, but hardly the size of Spitsbergen or Greenland. *But even if the archipelago consisted only of Bennet island and Sannikoff Land, the urgency, from a scientific point of view, of an exploration of these two islands would not be smaller than if we expected there the presence of larger extensions of land.*

I will mention briefly the scientific aims of an expedition to Sannikoff Land.

It would be needless to bring further proof for the assertion that such an expedition, made with a ship, would have to solve a series of *oceanographic problems*, of which the first would be the investigation of the dependence, so unexpectedly found by Nansen, of the Atlantic ocean on the polar basin.

The *topographical* and *geographical* questions which the expedition would have

* Cf. also A. Supan, "Die Norwegische Polarexpedition, 1893-96," in *Petermanns Mitteilungen*, Band. xliii., 1897, pp. 130 *seq.*

to solve, are already indicated in what has just been said. It need only be added that the working field of such an expedition would touch part of the unknown, *i.e.* never yet visited polar regions which reach the lowest latitudes in the eastern hemisphere.*

Among the physico-geographical researches, *geological* problems stand foremost. Some remarks on this subject have already been made in the exposition of the reasons which make one believe in the existence of an undiscovered archipelago in the north of the New Siberia islands. I will only add what solutions may be found in this region for most important questions relative to the latest periods of the history of our globe.

In the study of the Tertiary sediments which, as already said, must be expected to be found at Cape Emma, on Bennet Island, as a direct continuation of the New Siberia deposits, we meet with one of the most interesting problems, namely, How could sub-tropical plants thrive so near the pole under the present position of the Earth's axis of rotation? It is well known that in Greenland, Grinnell Land, Spitsbergen, and New Siberia, there are Tertiary deposits (Miocene?) which contain impressions of leaves and fruit-cones of several species of *Sequoia*, *Dammara*, and so on, as also large leaves of poplars and other trees which belong partly to a sub-tropical flora. Basing himself upon the words of Schiaparelli, who thinks that astronomy has nothing to object to a change in the position of the Earth's axis of rotation, if geologists prove the necessity of such an admission, Neumayer attempted to explain the, in his opinion, abnormal grouping of the Tertiary floras round the pole by the supposition of the pole having moved since the Tertiary age ten degrees from Northern Asia in the meridian of Ferro. In such case the pole of the Tertiary age would have been situated in the latitude of 80°, where this parallel passes through the archipelago which it is now proposed to explore. However, Nathorst, who has further worked out this theory, thinks that the pole ought to have been situated ten degrees southwards in the direction of North Asia, in which case, what was then the 80th degree of latitude would have passed, as it passed now, through the same archipelago.

The flora of the Tertiary "Wood Mountains" of New Siberia, which is now situated under the 75th degree of latitude, tells, in my opinion, against the theory of Neumayer and Nathorst. But Nathorst remarked that the fossil plants which I brought home in the year 1886, and which represent only fifteen species, are not sufficient to settle the point at issue. In that year I had but a few days for the exploration of the island of New Siberia and its "Wood Mountains," and I had but two dogs to transport my collection, my food supplies, and my baggage. How much better could the Tertiary deposits be explored during a year's stay in Bennet island, and how much more could be collected from the "Wood Mountains" if the collectors had a ship at their disposal for the home journey! I have no doubt that this new expedition would definitively settle the above question.

Another equally important problem is the Quarternary age. The original characteristics of the deposits belonging to that period have long since been explained for Europe and North America by the admission of a wide glaciation during the glacial period. As regards Asia, Prince Kropotkin was till lately alone in maintaining that parts of Asia, and especially middle Siberia, were also glaciated during the Quaternary period; but Northern Asia was considered till quite recently as having not been glaciated at all during the age when the Ice-period prevailed in the two other parts of the globe. Only my observations in the New Siberian islands in the year 1886, and at the mouth of the Anábar in 1893, and the testimony of

* Cf. A. Supan's 'Map of the Limits of the Unknown Polar Regions,' in *Petermanns Mitteilungen*, Bd. xliii., 1897, p. 15, plate 3rd.

Nansen about moraines and glacial striæ on the Taimyr peninsula gave positive evidence for the acceptance of glaciation in Northern Asia.* However, the observed facts seem to offer certain peculiarities, and to somewhat differ from the well-known traces of glaciation in Europe, so that a strict verification is required in order to levy *all* doubts. On the New Siberia island it is the "rock-ice," or the fossil glaciers as I have described them, which can be considered as the last vestiges of a former glaciation. The points of comparison between these fossil masses of ice and the present glaciers of the arctic regions cannot easily be found—the more so as the latter have been but insufficiently studied. Only the detailed investigations of E. von Drygalski, whose beautiful work has just been published, contain the basis upon which "rock-ice" can be better investigated.

If the rock-ice of New Siberia be a remnant of the old continental glaciation, as Drygalski is also inclined to accept with me, we may expect to find, on the islands farther north, the centre of radiation of that glaciation. A number of observations indicate that the motion of the continental ice-mass must have taken place in the New Siberia islands in a meridional direction. The exploration of the archipelago on the north of New Siberia will show whether this movement was directed from the north or not. Moreover, it will show whether I am right in my supposition that the Quaternary mammals of New Siberia inhabited a continent which had once a wide extension towards the north and the east, possibly being connected with America, and only gradually was cut into an archipelago. The sum total of the geological exploration of that archipelago, in connection with the comparative study of arctic literature of other regions, must finally throw new light upon the question whether the arctic islands altogether, with the exception of the New Siberia islands, which are undoubtedly continental islands—are remains of a broken up continent or not.

Going hand-in-hand with the geological observations, the *zoological* and *botanical* investigations will give further information concerning the just-mentioned question relative to the origin of these islands. It will appear whether their sweet-water fauna and flora are akin to the flora and fauna of the Asiatic continent only, or also contain an admixture of American species, or of such species as are characteristic of all other arctic lands. An equally great interest must be offered by *the study of the marine fauna*, and a still greater interest by the study of *the micro-organisms* in the snow flora and fauna, and especially in the fossil masses of ice.

The *meteorological* observations which would be made at a spot situated as far as possible north of the Siberian coasts would be of the greatest importance. They would give, so to say, a basis for the highly interesting meteorological observations which were made during the drift of the *Fram*, and consequently related, like all other travelling observations, to some new spot nearly every day.

As to the importance and necessity of observations on *terrestrial magnetism*, I permit myself to give, in connection with the subject, the following quotation only:—

"For our knowledge of the magnetic conditions of the Earth, the observations which we may make in the course of ten years cannot be a substitute for those observations which we lose the opportunity to make. What has not been done to-day is lost for ever; and the absence of these data will remain for ever a gap and a hindrance. Later on, but only after a long interval of time, it will, perhaps, be possible some day to reconstitute the present conditions in a theoretical way. But the perfection of the theory, which will be required for that end, will only

* Subsequently Vysotsky, who explored the lower Ob in 1896, and Inn. Lopatin, in the diary of his journey of 1866, which was only published in 1898, brought further proofs in favour of the glaciation of these regions.

then be attained when we shall have made for a long time consecutive observations over the whole surface of the Earth." *

I now will pass from these theoretical considerations to the practical question, *How can Sannikoff Land be reached?* The attempts of Sannikoff in 1806–1811, and of Lieut. Anjou in 1821–1823, have shown that with dog-sledges the land lying in the north of the New Siberia islands cannot be reached, on account of the *polynias* (open spaces). On the other side this can easily be done in summer, in a boat, as has been proved by De Long, on his return journey from Bennet island to New Siberia. However, a serious scientific exploration of those lands would be impossible under such conditions. For science' sake, it would be necessary to winter on Sannikoff Land, and in such case the shipping of the necessary provisions on sledges or in boats would evidently be impossible.

The only appropriate way to reach Sannikoff Land would be to make the passage in a ship—from the mouth of Lena, as will presently be shown. As might have been expected, the *Fram* expedition has proved that it is possible to attain the latitude of 78°—that is, the latitude of Sannikoff Land—in a few days by simply following the ice-free drift of the waters of the Lena.† True that in this latitude the *Fram* was frozen, and the famous drift of the unconquerable ship began therefrom. But it must not be forgotten that the *Fram* was very much belated, and that it was frozen on September 25. To avoid such an issue, which would be quite undesirable, it is evident that the journey should be made earlier in the season, and this can only be accomplished with certainty if the ship starts from the mouth of the Lena. That this last is quite free of ice in August is proved, besides many other testimonies, by my boat journey in the delta of the Lena in the year 1893.

There would also be another reason for taking the mouth of the Lena as the starting-point for an expedition to Sannikoff Land; namely, the possibility of providing the explorers with the necessary number of dogs, and the provisions for them. The best draught dogs in Siberia, and in the whole world, are found in the delta of the Lena. So that, if it were intended to reach Sannikoff Land in the course of one summer by starting from a European port, it would still be necessary to call at the mouth of the Lena to take the dogs, or at least (for the sake of saving time) at the mouth of the Olenek, where the dogs would have been prepared in advance. It is self-evident that in such case there would be the risk of missing that part of the season which would be best suited for reaching Sannikoff Land. It would thus be necessary, in order to be sure to attain the aim and to be well equipped, to spend two summers—not to mention that the ship which will next sail past Cape Chelyuskin may be less lucky than its three predecessors, the *Vega*, the *Lena*, and the *Fram*—and in such case may be compelled to winter at Cape Chelyuskin, and then spend a third summer on the way.

Consequently, it seems to me that the surest way would be to charter for the expedition a ship which would lie at anchor in the Lena the winter before. The steamer *Lena* is still there, but she is hardly in a state which would allow her to sail in the polar sea. It would thus be necessary to have another new ship. In case the available means would not allow of building or buying a new vessel, it seems to me reasonable to follow the example of the *Lena* of 1878, that is, to send a ship to the mouth of the Lena for purely commercial purposes. Such an enterprise, especially if a customs-free entrance of the goods at Yakutsk be granted, would be without doubt highly profitable; and it hardly would be advisable that such

* A. Schmidt, "The Geographical Problems of the Exploration of Terrestrial Magnetism," in *Verhandlungen des XII-ten Deutschen Geographentages*, 1897, p. 127.

† The *Fram* passed the mouth of the Olenek on September 15, and on September 20 she was in the supposed latitude of Sannikoff Land.

a ship should attempt to return the same summer with a cargo of goods exported from Siberia. Besides, the visit to the mouth of the Lena by a strong ice-resisting ship, under the guidance of an experienced Norwegian walrus-hunting captain, and the experience which would be thus won in the navigation of the Arctic sea in the waters surrounding New Siberia, would be an epoch-making fact. A successful navigation of the New Siberia waters would mean, on the one side, the beginning of a solid scientific exploration, and of a systematic study of the mammoth tusks wealth of these islands; and on the other side, it would be a prelude to the navigation eastwards of the Lena, to the mouth of the Kolyma, which would answer to a most pressing need of the population settled along this river. As an illustration of this need, it may be mentioned that, in consequence of the difficulties of transport by land, along the nearly 670 miles' long road from Yakutsk, across the 5000-feet-high Takulan pass of the Verkhoyansk range, the *pud* (36 lbs.) of rye-flour costs the Government 7 roubles 57 copeks (15*s.* 4*d.*) at Verkhoyansk; and from this last place the flour has to be taken nearly another 670 miles, until it reaches Kolymsk. What is the price of a *pud* of rye-flour at Nijni-Kolymsk, I don't know,* while the price of flour at Verkhoyansk is taken from an official communication which was made to me, in the year 1893, by the governor of the province of Yakutsk. It is evident that if the flour were sent every year on board ship from the mouth of the Lena, along the coast, to the mouth of the Kolyma, as also of the Indigirka, the Government would find in this mode of transport a great benefit.

As for the sale of European goods, if such be shipped from Europe, they would find, first, the Yakutsk market, and then the market of the gold-mines scattered on the large tributaries of the Lena. The returns of the Yakutsk fair, which takes place in summer, from July to the end of August, attain, according to official data, the figure of 2,000,000 roubles (£200,000), of which one-half represents the value of imports—chiefly cotton and woollen goods, china and earthenware, various colonial produce (excepting tea), and different chemical produce, while the other half represents the exports of fur goods and mammoth tusks.

As to the gold-mines, they are situated chiefly on the tributaries of the Vitim and the Olekma, and lately have been spread to those of the Aldan. The administrations of the two former regions spent, in 1889, the sum of 4,174,150 roubles (£417,415) for goods sold to the workers only. As to the needs of the gold-mines for technical purposes, it will be sufficient to name only dynamite, of which about 900 *puds* (about 33,000 lbs.) were used in 1889. It is certain that the orders for goods from one single of the larger gold-mines would be sufficient to richly pay the journey of a steamer *viâ* the polar sea to the mouth of the Lena.

The idea of a navigation between the mouths of the Lena and the Kolyma is so little new that Baron A. E. Nordenskjöld, more than twenty years ago, made the proposal to open a regular navigation between the Lena and Bering strait, and soon after that proved the possibility of realizing his scheme by his *Vega* journey. I was brought to the idea of the Lena and Kolyma navigation partly through my own knowledge of part of these regions, and partly directly by a considerable Siberian export firm, Gromoff & Co., and their representative, M. Pikhtin. This shows that there is already a demand for that navigation. My proposal is certainly not meant to be opposed to Nordenskjöld's plan, but, on the contrary, I consider its realization as equally desirable and practical.

* According to the testimony of a gold medallist of the Russian Geographical Society, who stayed at Kolymsk for four years and wrote a book about those regions, signed "Dioneo," the price of a *pud* of rye-flour is 14 roubles 70 copecs (£1 10*s.*). As to salt, its price raises to 1 rouble (2*s.*) the pound in the spring, and none is to be had at any price. All fish is eaten frozen and raw, for want of salt. (*Note of the translator.*)

The *realization of the expedition* would be, in short words, as follows:—

1. Next summer, in 1899, the ship—a good sea-going Norwegian walrus-hunter—ought to try to make its way *viâ* to Kara sea and past Cape Chelyuskin, to the mouth of the Lena. If the ship succeeds, as was the case with the *Lena* in 1878, to make its way through one of the arms of the mouth of the Lena, it must go up the river to Yakutsk, and, after having unloaded its cargo of goods, winter at Yakutsk or above that town in the Lena. If, however, no passage which would be suitable for the draught of the ship could be found in the delta of the Lena, the ship would find a good anchorage on the west coast of the Borkhaya bay. With the establishment of the winter, the goods could be easily carried by reindeer over the usual commercial road, about 67 miles long, and over the 1500-feet-high pass, across the 250-feet-high Kharaulakh mountains, to Bulun on to Lena, and from this depôt they would be carried further on on board the steamer *Lena*.

2. Next summer the expedition would start, after having provided itself at the mouth of the Lena with a number of the best dogs and reindeer, and previously, with a few Yakut ponies and with the necessary provisions for the animals. In August, taking advantage of the favourable Lena drift, the expedition could easily call at the New Siberia islands in order to establish there depôts. Then, judging from the experience of the *Fram*, it could reach the coast of Sannikoff Land in a few days. It would be desirable, if open water permits it, to penetrate as far north as possible, and to stop at one of the farthest northern spots of the discovered archipelago, or at the north end of Bennet island, in case the latter has a greater extension towards the north than Sannikoff Land.

3. Here the expedition would land, and the ship return to the mouth of the Lena. One part of the expedition would begin then the building of the house which they would bring with them, for establishing their winter quarters, and begin at once the meteorological and magnetical observations which would have to be carried on for a full year. In the mean time, the other part of the expedition may carry on the topographical and geological survey of the archipelago, so long as weather permits this to be done. In the spring and the summer the same work would be continued, so long as the ship does not come to take the expedition home.

4. On the return journey it is desirable to enlarge the field of observations by taking some other course, such as along the eastern coast of New Siberia, in which case a landing at the "Wood Mountains" would be most necessary in order to widely explore them and to make collections.

5. As to the composition of the expedition, it would be sufficient for me to have three collaborators,—an astronomer, a meteorologist, and a topographer. Besides, I would choose among the best *promyshlenniki* (hunters) a few Yakuts or Tunguses to act as hunters and dog-drivers.

Note by the Translator.

The translator of Baron Toll's admirable paper asks the author's permission to add the following considerations. If five-and-twenty years ago the necessity of exploring the flora of the Tertiary deposits *as near to the pole as possible* was considered as a weighty argument in favour of arctic exploration, the force of this argument is only the greater now. Four important sets of facts have been brought to bear since upon the solution of the question indicated by Baron Toll. On the one side, it has lately been maintained that the Tertiary vegetation which was discovered in polar regions may not have been so much sub-tropical as it had been supposed to be. But making full allowance for possible exaggeration of the amount of sun-heat (though not of *light*) that would be required by the Tertiary plants to grow in high latitudes, and fully admitting that these plants may have grown in

a northern temperate climate, the fact still remains that no imaginable redistributions of seas and sea-currents would account for the growth of even temperate-zone trees and shrubs in those high latitudes, especially when those latitudes were occupied by a large arctic continent. More fossil material from the highest latitudes is therefore required now, even much more than it was required when the remarkable conclusion of Oswald Heer as regards Tertiary vegetation became first known. The great question raised by Heer—and there is no other question of equal importance in the whole domain of Tertiary and Quaternary geology—will remain unsettled so long as we have not more fossil Tertiary plants from very high latitudes, in order to determine the true character of the sub-arctic Tertiary flora.

The latest discoveries relative to the changes of position of the Earth's axis of rotation have given new support to the hypothesis mentioned by Baron Toll, according to which hypothesis the pole may have been situated in Tertiary times several degrees southwards from its present position. The curve which the pole has described within the last few years is—we now know—a spiral, not a closed circle. But, with all that, the distribution of the tertiary vegetation round the pole seems to indicate that the climate was warmer in *all* directions from the pole. A change in the position of the axis may thus be insufficient to explain the facts relative to the Tertiary flora when these become known in their totality. We *must* therefore know the Tertiary flora of high latitudes *in its entirety*; otherwise we are bound to float in incertitude amidst the different hypotheses.

A third set of facts which have lately been discovered, especially due to the latest investigations in the southern hemisphere, is the astounding similarity of the Tertiary flora all over the surface of the globe. These researches are far yet from being complete, but already they seem to indicate that during the Tertiary age the distinctions between the different zones of the Earth were not so sharp as they are now; the climate on the surface of the globe seems to have been more equal than it is at the present time. If this be true, if the sharp climatic distinctions which we now see between the different zones did not exist in Tertiary times to the same extent and with the same sharpness as they do exist now, a great question arises; namely, was not that relative uniformity of climate due to a different composition of the atmosphere of our globe? And this question, of highest importance for geology, can only be solved by getting considerable quantities of fossil Tertiary plants from both the arctic and antarctic regions.

And fourth, a new hypothesis, which assumes, indeed, a change in the composition of the atmosphere, has been brought to the front by the great physicist, Arrhenius, and has been further developed by one of the greatest authorities on the recent geological history of the globe, Prof. Chamberlin, of Chicago. According to this hypothesis, the immense change in the climate of the globe, which took place between the Tertiary times and the Glacial period, may have had its cause in an increase of percentage of carbonic acid in our atmosphere. The volcanic eruptions which took place on an immense scale at the close of the Tertiary age in America, and in the arctic regions (and I will add, in the antarctic regions as well, and on the immense Vitim plateau and its border-ridges in Siberia), may have thrown into our atmosphere considerable quantities of carbonic acid; and Arrhenius has shown that even a very small addition of this gas to the atmosphere would considerably reduce its transparency for the heat-rays of the sun. Besides, one is naturally brought to the suggestion that the gases newly discovered in our atmosphere may also have varied in quantity at different geological epochs, the more so, as one of them, helium, is known to appear in a relatively great proportion in the waters of mineral springs, such springs being closely connected with volcanic outbreaks. In short, the variable constitution of the atmosphere may have been

the cause of changes of climate all over our globe, and one of the most vital geological questions is now to ascertain what was the real composition of the Tertiary flora, not only in the temperate zone, but especially in the arctic and antarctic regions. What was the extent of change in climate which we are bound to admit?

Let me also add that, since botanists have so well proved lately that the flora of each separate region of the globe is a direct descendant, and bears the stamp of the flora which clothed that same region in Tertiary times, the thorough and full knowledge of the Tertiary flora, in all the parts of the globe, becomes a matter of first importance for the evolutional botanist.

Taking everything into consideration, it is no exaggeration to say that, once there is a hope of discovering new beds of Tertiary plants in Sannikoff Land and Bennet islands, *this hope alone*, apart from all other geographical and oceanographical considerations so well indicated by Baron Toll, *would be a sufficient reason for sending out an expedition for the exploration of these Tertiary deposits.*

The same applies in full, and even much more, to the necessity of sending out an antarctic expedition to explore the Tertiary plants, the presence of which has been indicated by both Carlsen and Borchgrevink.

P. Kropotkin.

RUSSIAN NAVIGATORS IN THE ARCTIC OCEAN IN 1895-96.*

Communicated by Colonel J. SHOKALSKY.†

The special expedition organized by the Ministry of Marine in 1894 to explore the estuaries of the Obi and Yenisei and part of the Kara sea, wintered at Yeniseisk, and on the approach of spring was engaged in repairing the vessels—the s.s. *Lieut. Ovtsin* and sailing barge *Lieut. Skuratov*, the former drawing 8½ feet of water.

In the previous year (1894) they had made a successful trial of the coal obtained from the Alexander Nevsky mine, near one of the right tributaries of the Yenisei—the Dudinka, and, finding its quality to be not inferior to that of English coal, decided on making exclusive use of it for the future.

While these preparations were being made, the commander of the expedition, Lieut.-Colonel A. J. Vilkitsky, together with Lieut. K. V. Ivanov, determined by telegraph the difference in longitude between Yeniseisk and Krasnoyarsk, the former serving as the base for the astronomical work of the expedition. Vilkitsky also conducted, in 1894 and 1896, a series of observations with an apparatus of reversible pendulums by Repsold belonging to the Imperial Russian Geographical Society, by whose desire these observations were undertaken.

On June 15 the expedition left the town of Yeniseisk by the river, and on their way down fixed the position of the village of Gelahino, and observed the magnetic elements at this place and at Dudinsk, where they also took pendulum observations. On July 17 they reached the estuary of the river, and entered the sea to the west of Sibiriakov island. Finding, however, the Gulf of Yeniseisk still

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* Map, p. 224.

† Colonel Shokalsky, who has obligingly forwarded this report containing data from unpublished sources, and three charts of this northern navigation, corrected according to recent observations, besides the sketch-map alluded to hereafter, is the Secretary of the Physical Section of the Imperial Russian Geographical Society. He was one of the Russian delegates and a Vice-President at the International Geographical Congress held in London in 1895, at which he communicated a paper on the "Maritime Route to Siberia" (see 'Report of the Sixth International Geographical Congress,' p. 239).

obstructed by ice, they turned back, and spent a week in surveying the Korsakov group of islands and the south coast of the gulf. They also succeeded in fixing a position on the south coast of Sibiriakov island, and carried out magnetic observations there. On the conclusion of this work, they made a second attempt to enter the open sea near Mateh Saleh, but were once more obliged to retire southwards on account of the ice. They accordingly went to an anchorage at Zverevo, near the entrance to the Gulf of Yeniseisk, situated on the west coast. Here they experienced a storm of three days' duration, and then again put to sea, but were caught in a second storm off Sibiriakov island, which caused them no further damage than the loss of an anchor, though they were in some peril of being wrecked on the sand-banks off this island. On August 9 they resumed their voyage, meeting with two floes of rotten ice drifting northward from Lake bay. Forcing their way through these, they stood towards that part of the peninsula of Mateh Saleh visited the previous year by the *Lieut. Ovtsin*. Finding a depth of only 15 feet near the cape, they went north and then east to get more sea-room. Here they met with a large sandy island, which they rounded by keeping to the 5-fathom limit, having the ice-belt in sight to the northward the whole way. They coasted along this island for 30 miles, fixed its position on the chart, and discovered that its southern extremity, ending in a steep cape, bore a complete resemblance to the land seen and described by Lieut. Schwede of the s.s. *Lieut. Malygin* in 1893.

They now set their course for Biely island, intending to fix its position, but thick weather and the arduous work they had before them of surveying the almost unknown Gulf of Obi rendered further delay inexpedient; so, without waiting for fair weather, they turned southwards and entered the wide Gulf of Obi, stretching along the meridian for 400 miles. The navigation here was not difficult, the depth throughout being 10 to 12 fathoms, and no ice being met with. While at anchor off Cape Three Points, at the entrance of Tazov bay, they rode out a storm with the loss of only one cable.

Astronomical observations proved that the whole of the east coast of the gulf was incorrectly placed on the chart, and required shifting 40 miles to the westward, while the position of Cape Three Points was incorrect to the extent of 55 miles.

On reaching the southern part of the bay, they attempted to approach the mouth of the river Nyda or Nadim, but found this impossible owing to shallows, the south wind which had blown persistently for three weeks having driven the water to the northward, and lowered the depth on the bar of the Obi. Four days were spent in discovering the channel, and it was August 24 before they entered the so-called Hamanelsky Obi, the northern channel of the delta, having previously fixed the position of Entrance island and Cape Hamanelsky. On August 30 they arrived at Obdorsk after a successful season's navigation in the Arctic ocean and Gulf of Obi.

The results obtained include accurate positions and definitions of the coasts of the Gulf of Yeniseisk, Sibiriakov island, and the east side of the Gulf of Obi; astronomical positions along the rivers Yenisei and Obi; and a continuous series of magnetic observations from Yeniseisk to Port Dickson and along the Obi. It was found that both sides of the Gulf of Yeniseisk, east and west of Sibiriakov island, were equally deep and free from all hidden dangers. The west coast is more sheltered than the east, but not so accessible, except in clear weather, because Sibiriakov island, which has to be passed at a distance of 8 miles, lies low and cannot be sighted in hazy weather, and is, moreover, surrounded by shoals. By going east, navigators may run a straight course from Cape Mateh Saleh to the North-eastern islands, and from these may pass Sibiriakov island in any weather. The North-eastern islands, being about 200 feet above water and very steep, are

easily approachable. The island discovered by the expedition to the north of Cape Mateh Saleh may be passed in clear weather at a distance of one or even half a mile; but in fog a more northerly course should be held, in soundings of not less than 7 to 8 fathoms.

Neither is the navigation of the Gulf of Obi dangerous. Keeping the east coast in sight from Cape Droviany, they had even soundings gradually diminishing as they went south, and it is only on the west coast off the Hamanelsky Obi, opposite the Yada, that shoals are frequent. The navigation of this gulf is, moreover, facilitated by the fact of the bottom being soft mud, and only sand on the banks. These too begin gradually, so that when the soil brought up by the lead is gritty, precautionary measures have to be taken. There are no rocks either in the gulf or the river Obi.

The navigation of the Yenisei as far as the town of Yeniseisk showed a depth throughout of 4 fathoms. The channel discovered in 1894 off Cape Gostinny was definitively surveyed in 1895, and found to have a depth of not less than 4 fathoms near Cape Doroféyev. Hence it is superior in every way to the older channel, which has only 15 feet of water, and the Lukovaia arm forms a natural harbour accessible to ocean steamers.

Meteorological and hydrographical observations of tides and currents were systematically undertaken, and a variety of notes and collections relating to natural history, anthropology, etc., were made by Midshipman Botkin, M.D. The length of the seconds pendulum was observed in four places, the northernmost of these being on the North-eastern islands in lat. 73½° (Port Dickson).

In 1896 the expedition left the city of Tobolsk on June 4, and entered the Gulf of Obi on the 24th of this month. By August 11 they had completed their survey of the southern part of this gulf and proceeded northwards; on August 22 they entered Yugor strait, and on September 16 arrived at Archangel.

Descending the Obi, they fixed the positions of the village of Elizarovo, the town of Beriosovsk, and the village of Obdorsk, filled in soundings on existing charts, and corrected shore-lines, changes having taken place at the river-bends owing to spring floods. The lesser Obi was navigated from Beriosovsk, the maps of the greater Obi having been corrected the previous year.

The river entrances were carefully examined, but none were found deeper than 9 feet towards the left coast. Crossing to the right, they ran a line of soundings along the bar, and found a depth of 12 feet under the right coast, all other parts averaging 9 to 10 feet. This proves that vessels drawing 12 feet and upwards cannot enter the Obi. Hence it became necessary to discover a sheltered bay where large steamers might safely discharge their cargoes, and thus secure the importance to commerce of the mighty Obi system. Such a harbour was discovered about 20 miles north of Cape Yam Saleh, with 17 feet of water, only exposed to light rollers with a wind from the opposite right shore. This bay, named "Nahodka" (Discovery) bay, has been surveyed in 1897 by an officer of the hydrographical service specially sent for the purpose.

Having completed their survey of the bar, they sketched in the left coast of the gulf and the southern part of the right coast. Numerous sandbanks were found along the former, but none near the latter. Neither were there serious inaccuracies in former charts to correct, as was the case in the previous year's survey of the east coast. Only here and there was it found necessary to shift the coast-line a little to the west. This result might have been anticipated, owing to the circumstance of the survey of the west coast having been corrected in the second decade of the present century, while that of the right or east coast refers back to the Great North Russia expedition about the year 1730.

In rounding Biely island fog interrupted the survey, and no good positions could be fixed, but the soundings led to the belief that existing charts of this part are fairly accurate.

There is now nothing to hinder this northern navigation, and no systematic survey will have to be undertaken in the future; occasional corrections may be made as the opportunity occurs, and next summer it would be advisable to send an officer overland to examine in detail the bay near the bar of the Obi river.

Four astronomical positions were fixed on the coast of the gulf, besides numerous observations from the deck of the vessel; the position of the church in Yugor strait was also fixed, and the magnetic elements ascertained in seven places. In Tobolsk itself, as well as in Beriozovsk, Obdorsk, and Yugor strait, observations with the pendulum were also made. Meteorological and hydrographical observations were continued every four hours. The weather was altogether unfavourable, and on entering the Kara sea the two vessels, the s.s. *Lieut. Ovtsin* and the barge in tow, were for four days exposed to a violent storm from the north, south-west, south, and north-west, accompanied by fog and rain. The steamer ran short of coal, and had it not been for their adopting the novel expedient of coaling by slinging the sacks on the tow-rope and hauling them by means of a block and pulley from the barge to the steamer, it might have fared badly with them. By dint of incessant exertion on the part of officers and men the furnaces were kept supplied, and the little steamer with her charge weathered the storm.

The incidents of this storm are told by Colonel Shokalsky, but we are obliged, for want of space, to curtail his narrative.

When the weather at last moderated, and they were so fortunate as to enter Yugor shar or strait, one of the steamer's screws was disabled, the stock of coal was reduced to one sack and a half, and the officers and crews of both vessels were in a state of exhaustion. In Yugor strait they met with two English steamers at anchor, waiting the arrival of Captain Wiggins. At the request of the English, they were supplied with the Russian maps, and it was probably due to these (though we are not told so) that these English vessels accomplished their voyage to the Yenisei so satisfactorily—one proceeded up the river, the other discharged cargo and returned safely to Norway. Acts of courtesy such as these deserve to be recorded, because they may help to allay that feeling of irritation which characterizes the relations of their respective governments in other parts of the world.

The sketch-map accompanying this paper is compiled from charts kindly supplied by Colonel Shokalsky.

Besides the above surveys, the *Jigit* cruiser, sent to the Glacial ocean in 1895 to protect the Russian fisheries in those seas, took out officers of the Hydrographical Department—Denisobransky and Jdanko—by whom the following surveys were made:—

1. A sketch-map of—
   - (*a*) The southern part of Pechenga bay (Varanger fiord).
   - (*b*) Cape Sétinsky and Volokov bay at the entrance to Kola bay.
   - (*c*) The southern part of the Kola bay.
   - (*d*) The straits of Kildyn.
   - (*e*) Major station and Voroniye Ludki.
   - (*f*) The southern part of Catherine harbour.
2. Boat soundings of—
   - (*a*) Pechenga bay (Varanger fiord).
   - (*b*) Waida bay.
   - (*c*) Kola bay.
   - (*d*) Teribersky bay.
   - (*e*) Part of the roadstead beyond the Yokan islands.

3. One hundred and seventy-one marine soundings.

4. Two hundred and seventy observations on the temperature and density of the surface water, and twenty-one series at different depths.

5. The entrances to Kola bay and Yokanka were buoyed.

6. Magnetic observations of all three elements at Kolguev island, Matochkin shar, Lesser Karmakul, Mushroom bay, and Catherine harbour.

7. Triangulation of church and station of Karmakul.

8. Astronomical positions of Mushroom bay in Novaya Zemlia and Kolguev island.

This last piece of work gave a particularly interesting result. The observations were made near the mouth of the Goose river on the north-west coast of the island. Its position on Russian charts was lat. 69° 27′ 30″, long. 48° 32′ 0″; on English charts (Imray) the position given is lat. 69° 27′ 30″, long. 48° 43′ 0″, or 11′ east of the position assigned on Russian charts. According to Jdanko, it should be lat. 69° 28′ 56″, long. 48° 51′ 9″, *i.e.* nearly 19′ of arc to the east of the Russian position, and 7′ east of the English.

A third expedition for hydrographic work has now been sent to the Kara sea by the Russian Admiralty, also under the command of Colonel Vilkitsky, on a new steamer, the *Pakhtusoff*, constructed at Middleborough, England.

UNITED STATES DAILY ATMOSPHERIC SURVEY.*

By WILLIS L. MOORE.

The United States Weather Service has been in existence twenty-seven years. During the past twenty-five years the daily synoptic charts of the service have shown the most comprehensive atmospheric survey ever presented to the forecaster, or to the broad investigator of the fundamental principles of storms. The vast region now brought under the dominion of twice-daily synchronous observations embraces an area extending 2000 miles north and south, 3000 miles east and west, and so fortunately located in the interest of the meteorologist as to cut an important arc from the circum-polar thoroughfare of storms of the northern hemisphere. The extreme points of observation are Edmonton, in the Canadian province of Alberta, on the north-west; St. John's, Newfoundland, on the north-east; Key West, on the south-east; and San Diego, on the south-west. And arrangements are now complete for a co-operation with Mexico similar to that in operation with Canada, and which will in a few months extend the area of observation southward over Mexico and Yucatan.

A wonderful panoramic picture of atmospheric conditions is, by the aid of simultaneous measurements and the electro-magnetic telegraph joining the places of observation by a magic touch, thus presented to the trained eye of the forecaster. Each twelve hours the kaleidoscope changes, and a new graphic picture of actual conditions is shown. Where else can the meteorologist find such opportunity to study storms and atmospheric changes?

In the middle of the eighteenth century Franklin detected the rotary and progressive motions of storms; early in the nineteenth century Redfield and Espy contended over rival theories as to the mechanical principle involved in the rotation of storms; and a little later Maury studied the winds of the Atlantic ocean; still

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* Paper read in Section E (Geography) at the Toronto Meeting of the British Association, August, 1897.

later, Loomis, Dové, and Ferrel reviewed these theories and added much to our knowledge; but at this late date no one has been able to satisfactorily co-ordinate the forces operative in cyclones, or to assign quantitative values to the horizontal temperature and pressure gradients, to the surface resistances and internal frictions of convection, to the latent heat of condensation, and to the effect of hemispherical circulation. Probably the only components of cyclonic force that are well understood and accurately computed are the centrifugence and the deflection due to the earth's rotation.

Our early investigators studied only the storms of low levels and humid airs, where convection only needed to carry the moist air-currents to a slightly higher elevation, when cooling by expansion produced condensation, and an immediate acceleration of the cyclone by the liberation of latent heat. They had never seen the whirling cyclones of the arid northern Rocky mountain plateau dash down upon our great lakes with rapidly increasing energy, notwithstanding the fact that there was little or no condensation, and hence no addition of the latent heat which Espy supposed was absolutely essential to a continuation of storms.

The great diversity in elevation, topography, temperature, and aridity of the broad region under our observation, constitute conditions unequalled anywhere in the world for the advantages which they present to the physicist to study the mechanical phases of storm development and progression, or, at least, so far as they can be profitably studied by means of observations taken only at the bottom of the great aërial ocean surrounding the Earth.

Here we see summer cyclones formed under the intense insolation which beats down through a cloudless atmosphere upon the arid waste of the Rocky mountain plateau; or winter cyclones, which, if they form in the northern part of the plateau region, move eastward to our lakes, and thence to the St. Lawrence, with scant rainfall; cyclones which, if they have their origin farther south, on the warmer plains of Colorado, move into the Ohio valley, and thence into New England, with considerably more precipitation; and cyclones which, if they have their inception on the high plains of Arizona and New Mexico, can always be expected to give abundant rainfall when they reach the Lower Mississippi valley, and later, as they pass over the Middle Atlantic states. All of these conditions can be studied during their inception at an average altitude of 5000 feet above sea-level, and under conditions of extreme aridity; they can be viewed later, as they come down nearly to sea-level in the Mississippi valley and reach a more humid atmosphere, 1000 miles from the place of their birth; and, finally, they are seen as they reach the extremely humid air of the Atlantic ocean, 1500 miles farther east.

The great winter cyclones, which originate south of the Japanese islands and cross the Pacific ocean, come under our vision as they successfully surmount the formidable Rocky mountain barriers with but little diminution of energy, sweep across our continent with increasing force and heavy precipitation, and, within three days, pass beyond our meteorological horizon at the Atlantic seaboard, only to be heard from three days later as borean ravishers of Northern Europe.

The great anti-cyclones, or high-pressure eddies, which constitute the American cold-waves, drift into our territory from the Canadian North-West Provinces, and, by means of our charts, are studied under rapidly changing conditions during 3000 miles of their course. The high-pressure eddy, with all the convectional principles of the cyclone reversed, may be said not to depend upon the land of its birth for the cold it brings; for a strong vortical and anti-cyclonic motion at the centre is continually drawing down the cold air from above. In the cold wave it must be conceded that the loss of heat by radiation to a cloudless sky is much greater than that dynamically gained by compression, or else it must be assumed that the

atmosphere possesses such intense cold at the elevation from which the air is drawn that, notwithstanding the heat gained by compression in its descent, it is still far below the normal temperature at the surface of the Earth.

The West Indian hurricanes, always at sea-level and in humid air, and which are the most violent of all American storms, intrude themselves into the domain of the United States weather-map at the bend of their parabolic course, at about latitude 30°. They have for years furnished a fruitful theme for the thoughts of the investigator.

For twenty-seven years the forecasters of the Weather Bureau have studied the inception, development, and progression of these different classes of atmospheric disturbances. From a knowledge personally gained by many years' service as an official forecaster, I do not hesitate to express the opinion that we long since reached the highest degree of accuracy in the making of forecasts possible to be attained with surface readings. It is patent that we are extremely ignorant of the mechanics of the storm, of the operations of those vast yet subtle forces in free air which give inception to the disturbance, and which supply the energy necessary to continue the same. Long having realized this, I determined at once, on coming to the control of the United States Weather Bureau, to systematically attack the problem of upper-air exploration, with the hope ultimately of being able to construct a daily synoptic weather-chart from simultaneous readings taken in free air at an altitude of not less than 1 mile above the earth. Prof. Marvin was assigned to the difficult task of devising appliances and making instruments, and I am pleased to say that we have improved on kite-flying to such an extent that apparatus is now easily sent up to a height of 1 mile in only a moderate wind. We have made an automatic instrument which, while weighing less than two pounds, will record temperature, pressure, and wind-velocity. By January next we hope to have not less than twenty stations placed between the Rocky mountains and the Atlantic ocean, taking daily readings at an elevation of 1 mile or more.

We shall then construct a chart from the high-level readings obtained at these twenty stations, and study the same in connection with the surface chart made at the same moment; being thus able to map out the vertical gradients of temperature, pressure, and wind-velocity, as well as the horizontal distribution of these forces, it is hoped to better understand the development of storms and cold-waves, and eventually improve the forecasts of their future course, extent, and rate of movement.

In exceptional cases we have flown the kites to a height of $1\frac{3}{4}$ mile. From daily readings at only one kite station, at Washington, we have derived information as to the force and direction of the wind above the 1-mile level, which has greatly assisted us in estimating the future direction of a storm-centre when our surface chart gave but negative indications. It will be a fascinating study to note the progress of cold-waves at this high level, and to determine if the changes in temperature do not first begin above. The readings at Washington indicate that contending equatorial and polar winds may be more potent in the formation of storm-eddies than heated and ascending convectional currents.

I am anxious to know the difference in temperature between the surface and the upper stratum in the four quadrants of the cyclone and in the four quadrants of the anti-cyclone, especially when the storm and cold-wave conditions are intense. At an elevation of 5 miles but little effect remains of diurnal temperature variation. At this altitude the atmosphere is free from the disturbing influence of immediate surface radiation, and consequently there is but little change between the temperature of midday and midnight. The vertical distribution of temperature in the several quadrants of the cold-wave or rain-storm areas may give a clue to the future

direction of the storm—to the little aberrations in direction which cause the forecaster to fail in his predictions for considerable areas. When we are able to construct isobaric gradients at the 1-mile level, it may be discovered that the storm-centre at that elevation will not always coincide with the geographica location of the storm-centre at the surface of the Earth. The displacement of this centre may possibly give some indication of the future direction of the storm. In other words, there are many interesting problems to be solved by this investigation.

PERSIAN GULF NOTES.

KHARAG ISLAND.

By Captain A. W. STIFFE, R.I.M.

A FEW notes on this island may be of interest, there being ancient remains as well as more recent ones of the time of the Dutch settlement. Kharag is 4 miles long, and 3 miles broad at the northern end, being roughly triangular in shape, and lies off the Persian coast 31 miles north-west by west from Bushire.* It is hilly, except the north-east corner, and the ground very broken and rocky. The hills are capped with a thin bed of nearly horizontal calcareous breccia of tertiary age, under which is a great thickness of softer beds, which are being gradually removed by rain and wind, when the upper crust breaks up and falls in large slabs and masses, and presents a curious picture of desolation. The highest part is 284 feet above the sea, and is occupied by a small tomb. The village on the low north-east point is inhabited by fishermen. It was for many years the home of the pilots for the river (the Shat-el-Arab), and all vessels bound to Basrah had to call here for their pilot for the river.

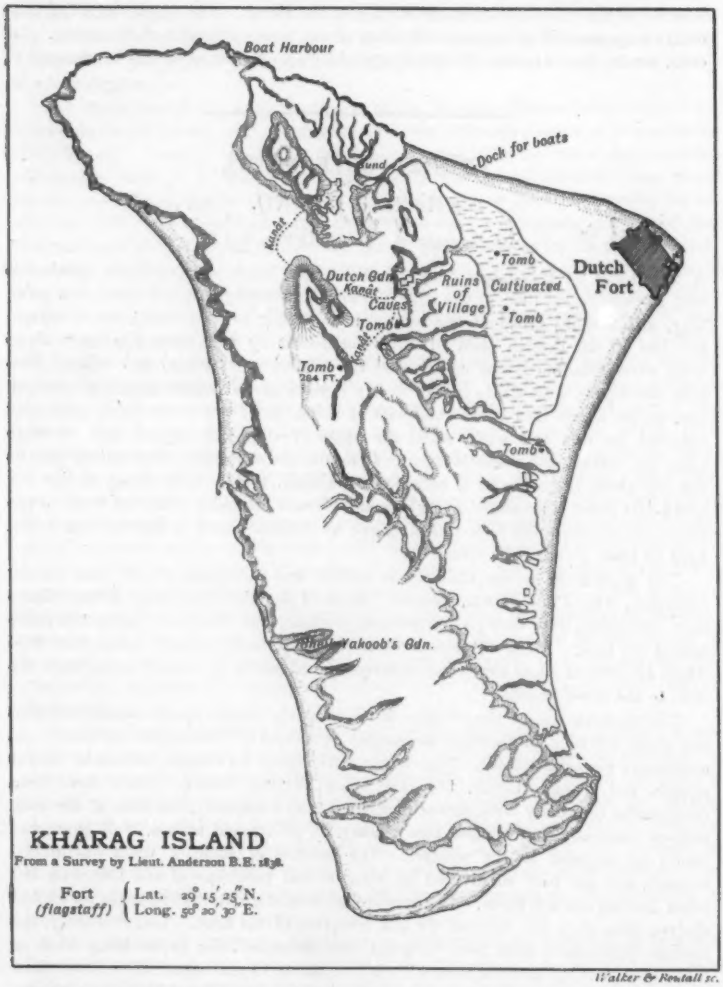
The population at the time of the survey was estimated at 400 men, mostly fishermen, with a few Persian soldiers. Much of the plain and many of the valleys were cultivated, with date plantations and gardens, and there were flocks and herds among the hills. A few antelope were to be found, mostly on the north-west side. There are several short kanâts, or underground channels, to convey water from the hills to the lower ground.

The most ancient of the remains found here, are certain small caverns hollowed out of the soft rock, and coffin-like troughs excavated in the surface of the rock, all apparently for burial-places. The largest of the caves we entered was about 15 feet square, and 8 high inside, the roof being slightly domed. They have been ornamented internally with carved mouldings, and externally, the face of the rock scarped vertically and worked into tracery of pillars and arches, well preserved where not exposed to the weather. The interior of some of them has arched recesses, and has been subdivided by thin vertical partitions of the live rock left when hewing out the caves. In these are horizontal grooves, apparently for sliding shelves, from their size adapted for the reception of the dead. Unfortunately, the vertical party-walls have been in great part destroyed, the caves being used as cattle-pens, but the grooves were still perfect, about 1½ feet apart, and in four tiers.

Of later remains, the principal is a tomb with a spire (sketch) standing behind these caves, higher up the hillside. It is said to be of Mir Muhammad, a son of

* Properly Abu-Shahar, but the English corruption is so general that it seems impossible now to establish the correct name (see map of island reduced from Lieut. Anderson, R.E.).

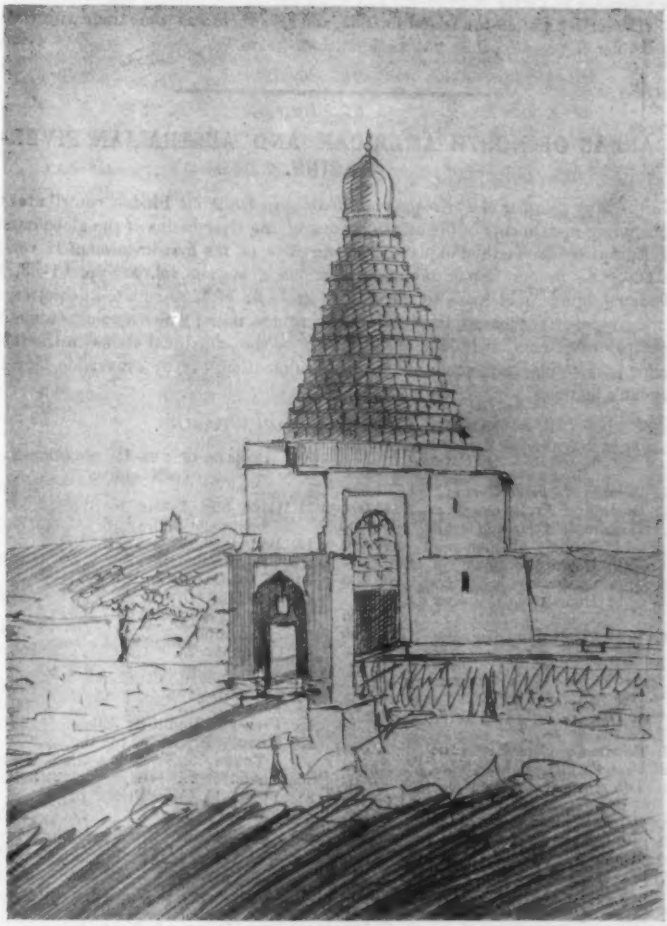
Ali, and has an inscription stating it was rebuilt nearly six hundred years ago. It is still a place of pilgrimage.* There are several other shrines; in one is shown a mark in the rock, said to be the impression of the hand of the prophet el-Khizr.



There is also a tomb 40 ells in length, called Chehil-gazah, of a saint said by tradition to have been of that stature.

* The island is referred to as a place of pilgrimage by Yakút, 1218, who visited it on his way to Kis ('Dict. Geogr. de la Perse from Yagout.' By C. Barbier de Meynard. Paris: 1861).

On the low north-east point stands the old fort erected by the Dutch in 1754, after they had abandoned Bandar Abbas, and had been compelled to leave Basrah.* They established themselves here in order to command the trade with that place, and it quickly rose to some importance under its founder, Baron Knyphausen, a



TOMB OF MIR MUHAMMAD.

man of genius. It encloses a large space of ground within a bastioned wall, now utterly ruinous, except the citadel at the north-east corner which is occupied by a small Persian garrison. Under the Baron's successor, in 1765, it was taken from the Dutch, one account says by treachery, by Mir Muhannah, the pirate chief of

* In 1748, during the Afghan invasion of Persia, when their factories were plundered.

Bandar Ríg,* a small port on the main, and they do not seem to have attempted to re-establish themselves either here or at any other place in the gulf.

I do not find any reference to the early history of the place in any of the old geographers, it being only mentioned by name. The British occupied the island as a menace to Persia in 1838–42, and again during the Persian war of 1856–7.

Thevenot† visited the island in 1665, and says there was some trade with Basrah to Bandar Ríg and Ispahán "to avoid custom-house."

AREAS OF NORTH AMERICAN AND AUSTRALIAN RIVER-BASINS.

To the May number of *Petermanns Mitteilungen* Dr. Alois Bludau contributes the concluding instalments of his recalculations of the river-basins of the globe outside of Europe by the method explained in our note on the first instalment in vol. ix. p. 666. As in our former tables at that place, and in vol. xi. pp. 61–63, Dr. Bludau's figures, which are to the nearest multiple of 1000 square kilometres, are here given to the nearest multiple of 500 square miles, which explains some discrepancies between the totals and the sum of the individual items in the tables below, the totals being obtained, not by summation, but by conversion from Dr. Bludau's figures.

NORTH AMERICAN RIVER-BASINS.

A. General Synopsis.

	Sq. miles.
1. Domain of Pacific Ocean...	1,731,500
2. Domain of Arctic Ocean...	2,444,000
3. Domain of Atlantic Ocean	
(*a*) Domain of open sea	992,500
(*b*) Domain of Gulf of Mexico	2,009,500
(*c*) Domain of Caribbean Sea	131,000
4. Regions of inland drainage	393,500
	7,701,500

B. Domain of the Pacific Ocean.

1. Panama to Cape Elena ...	23,000
2. Cape Elena to Tehuantepec	35,000
3. Tehuantepec to Petacalco Bay	28,500
4. Petacalco Bay to San Blas	68,500
5. Rio Grande de Santiago ...	50,000
6. Rio de Mesquital ...	19,000
7. Rio de Mesquital to Rio Yaqui	51,500
8. Rio Yaqui and Rio de la Asuncion	68,500
9. Rio Colorado	228,000
10. Rio Colorado to Cape San Lucas	6,000

B. Domain of the Pacific Ocean—*continued.*

	Sq. miles.
11. Cape San Lucas to the boundary of the U.S. ...	17,500
12. Boundary of the U.S. to San Francisco	22,000
13. San Joaquin and Sacramento	48,500
14. San Francisco to the Columbia	40,500
15. Columbia	253,000
16. The Columbia to the Frazer	20,000
17. Frazer	90,000
18. Frazer to Mount St. Elias	123,500
19. Mount St. Elias to the Yukon	197,000
20. Yukon	305,500
21. Yukon to Cape Prince of Wales	25,500
	1,731,500

C. Domain of the Arctic Ocean.

1. Cape Prince of Wales to Mackenzie river ...	160,000
2. Mackenzie...	641,000
3. Mackenzie to Repulse bay	276,000

* Niebuhr, 'Travels in Arabia in 1762,' refers to this potentate as a "detestable monster."

† 'The Travels of M. de Thevenot into the Levant.' London: 1687. Newly done out of French.

C. Domain of the Arctic Ocean—*continued.*

	Sq. miles.
4. Repulse bay to Churchill river	177,500
5. Churchill	158,500
6. Churchill river to Nelson river	7,500
7. Nelson	417,000
8. Nelson river to Cape Chidley	606,000
	2,444,000

D. Atlantic Domain.

A. Domain of the Open Sea.

1. Cape Chidley to the St. Lawrence	169,000
2. St. Lawrence	482,000
3. St. Lawrence to the St. Croix inclusive	67,500
4. St. Croix to Cape Cod	32,000
5. Cape Cod to Sandy Hook	35,000
6. Sandy Hook to Cape Henry (Chesapeake bay)	84,500
7. Cape Henry to Charleston	75,500
8. Charleston to the Straits of Florida	47,000
	992,500

B. Domain of the Gulf of Mexico.

9. Straits of Florida to the Mississippi	149,000
10. Mississippi—	
(*a*) Left bank from the mouth to Cairo	32,000
(*b*) Ohio	204,500
(*c*) Left bank from Cairo to the source	120,000
(*d*) Right bank from the source to St. Louis	84,000
(*e*) Missouri	519,500
(*f*) Arkansas, Red river, and rest of right bank	293,500

D. Atlantic Domain—*continued.*

	Sq. miles.
11. Mississippi to Rio Grande del Norte	193,000
12. Rio Grande del Norte	220,000
13. Rio Grande del Norte to Rio Panuco	21,000
14. Panuco	38,000
15. Tampico to Santa Anna (isth. of Tehuantepec)	46,500
16. Santa Anna to Laguna de Terminos	62,000
17. Laguna de Terminos to Cape Catoche	25,000
	2,009,500

C. Domain of the Caribbean Sea.

18. Cape Catoche to False cape	74,000
19. False cape to Monkey point (Pta. Gorda)	30,000
20. Monkey point to Ochoa (Greytown)	18,000
21. Ochoa to Colon	9,000
	131,000

E. Regions of Inland Drainage.

1. Great Basin and Mohave desert	208,500
2. Tulare lake	14,500
3. Gila desert south of the Rio Gila	13,500
4. Colorado desert and interior of Lower California	36,500
5. Sierra Madre plateau	34,000
6. Mexico between San Luis Potosi and Rio Grande del Norte	87,000
	393,500

AUSTRALIAN RIVER-BASINS.

A. General Synopsis.

1. Domain of the Pacific Ocean	240,500
2. Domain of the Indian Ocean	1,127,000
3. Regions of Inland Drainage	1,567,500
	2,935,000

B. Domain of the Pacific Ocean.

1. Cape Wilson to Mount Lindsay	67,000
2. Mount Lindsay to Keppel bay	31,000
3. Fitzroy	54,500
4. Keppel bay to Trinity bay	68,000
5. Trinity bay to Cape York	20,500
	240,500

C. Domain of the Indian Ocean.

A. Cape York to the North-west Cape.

1. Cape York to Melville bay (Gulf of Carpentaria)	235,500
2. Melville bay to Roebuck bay	201,000
3. Larrey point to North-west cape	87,500
	524,000

C. Domain of the Indian Ocean—*continued.*

B. North-west Cape to Point D'Entrecasteaux.

	Sq. miles.
4. North-west cape to Steep point	52,000
5. Steep point to Mount Peron (30° S.)	60,000
6. Mount Peron to Point D'Entrecasteaux ...	44,500
	156,500

C. Point D'Entrecasteaux to Cape Wilson.

7. Point D'Entrecasteaux to Wattle camp (Culver point)	23,000
8. Wattle Camp to Point Bell (Denial bay)	8,000
9. Point Bell to Port Augusta (Eyria peninsula) ...	25,500
10. Port Augusta to Murray ...	11,000

C. Domain of the Indian Ocean—*continued.*

	Sq. miles.
11. Murray	351,500
12. Murray river to Cape Wilson	27,000
	446,500

Whole domain of the Indian Ocean, 1,127,000 square miles.

D. Regions of Inland Drainage.

1. Paroo and Bulloo river ...	62,000
2. Lake Eyre basin	417,000
3. Basin of Lakes Torrens and Gairdner	39,500
4. Lake Frome basin ...	45,500
5. Wimmera	34,000
6. Remainder of South and West Australia and Alexandra Land ...	969,000
	1,567,500

THE GLACIERS OF RUSSIA IN 1896.

Owing to the initiative of Prof. Mushketoff, regular observations on the growth and decrease of glaciers in various parts of the Russian empire began to be made a few years ago, and we have now (*Izvestia* of the Russian Geographical Society, 1897, iv.) the results of the measurements and the new discoveries which were made in 1896.

I. The Caucasus.—Thirteen glaciers were visited in the Caucasus: eleven on the northern slope of the Central, the North-Western, and the South-Eastern Caucasus, and two on the southern slope. All thirteen glaciers continued to decrease in length, the averages (some of them based upon eight to ten years' averages) being on the northern slope—15·4 metres for the Central Caucasus, 23·2 for the North-Western Caucasus, and 38·8 for the South-Eastern Caucasus; and 24 to 26 metres on the southern slope. The general averages may be taken as follows: northern slope, 22 metres; southern slope, 25 metres.

Some glaciers which have been measured for the last eight to eleven years gave the following results:—

8.	Glacier	Tzeiski,	decrease	in	10	years	... ...	184	metres.
9.	„	Rekomski	„		10	„	... ...	95	„
16.	„	Kalaki	„		10	„	... ...	160	„
21.	„	Chacha	„		8	„	... ...	170	„
24.	„	Khakel (sources of N. Klukhor), decrease in 8 years						192	„
26.	„	Chapchakhi, decrease in 11 years						286	„
33.	„	Khakel (sources of S. Klukhor), decrease in 8 years						264	„
38.	„	Osukako, decrease in 11 years						488	„

On the Kabish glacier the *névé* masses have shown an increase in height of 3·2 metres (1·4 metre since 1895).

Besides, two explorers, N. A. Bush and N. N. Schukin, who were sent out by the Society for botanical investigations, have visited about forty glaciers, several of which were not known before. All the glaciers visited are in a phase of decrease, as was already known from Rossikoff's and Mushketoff's work.

II. Turkestan.—MM. Lipskiy and Barschevskiy have discovered in the Hissar range a number of glaciers formerly unsuspected; namely—

1. Glacier of Severtsoff in the Khazret Sultan mountain group; the end of the glacier lies at an altitude of about 10,500 feet.

2. System of Zigdi (affluent of Varzob, tributary of Kafirnagan). The Zigdi range has on its northern slope the glaciers Zigdi, Sangal, and Buzlyuk, all buried in snow.

3. System of Yagnob: (*a*) On the Barzenga river (chief headwaters of the Yagnob) three great glaciers, the largest of which is immense; it has received the name of Count Rostovtseff; its end is at the altitude of 11,200 feet; top, 13,000 feet; nearly all covered with snow. (*b*) Three glaciers belonging to the system of the Sangdarà river; the largest flows towards north-north-east, and its end attains the 12,500-feet level; and (*c*) the small glaciers Rivut, Tavastvin, Karg, and Kavosang in the Zerafshan range, on the right-bank tributaries of the Yagnob.

4. A small glacier, Kalta-kul.

5. Two big glaciers, one of them reaching the 11,000-feet level (Sokoloff's) on the Tash-kuvat, tributary of Sorbo.

6. A group of big glaciers at the headings of the Namrut river (Mushketoff's, Namrut, Dibarar, Galaist, Galagan), having big circuses, and reaching by their lower ends various levels of from 10,500 to 11,500 feet.

7. Several glaciers, one of them a big one, on the Pakshif, Susob, and Kamarau rivers.

8. A group of large glaciers, Muraka.

9. Several glaciers are also mentioned on the upper tributaries of the Kabud.

Summing up the observations of the expedition, M. Lipskiy writes that most glaciers lie on the northern slope, in groups, especially in the upper parts of the Yagnob. They are mostly buried in snow, and most of them are of easy access. Large moraines, which are seen below the ends of the present glaciers, and large accumulations of morainic *débris*, show that all the glaciers are in a phase of decrease.

M. Maslovskiy's photographs of the lower end of the great Zerafshan glacier show that it has decreased since 1881.

III. Siberia.—The chief interest belongs to the Altai glaciers of the Byelukha, which were visited in 1896 by Prof. Sapozhnikoff ('In the Altai,' Tomsk, 1897), and have, as it now appears, a much greater extension than they were supposed to possess. Thus, the Katuñ glacier consists of two branches, attaining respectively the lengths of $3\frac{1}{2}$ and $4\frac{3}{4}$ miles, while it was supposed to be only $1\frac{1}{2}$ mile long. Close by it lies the Black glacier, 2 miles long. They are all fed by the snows of the Byelukha peak, and are quite separate from the Berel glacier, which also consists of two branches, 2 miles, and about $1\frac{1}{2}$ mile long. The lower ends of the Altai glaciers attain the 6500-feet level. All the glaciers are now much smaller than they have been once.

Other glaciers have been seen at the sources of the Kapchal, and three new ones were discovered by Dr. Tronoff at the head of the Bukhtarma, namely, the Bukhtarma glacier, consisting of two branches, and reaching the 8000 feet level; the Ukok glacier, 5 miles to the east of the former, and about $1\frac{1}{2}$ mile long; and the Alakha glacier, about $2\frac{1}{2}$ miles long, and reaching the 8000 feet level. All are in decrease, as shown by their large abandoned moraines.

M. Soboleff has made some good photographs of the Katuñ glacier (*Zemlevyedeine*, 1896, part iv.), as also a relief of the Katuñ mountains.

M. Ignatoff (same periodical, 1897, parts i. and ii.) has discovered a new glacier in the Kimas mountains, at the head of the Bukhtarma, in the South Altai range.

THE MONTHLY RECORD.

EUROPE.

Caucasus.—The nineteenth volume of the *Memoirs* of the Caucasian branch of the Russian Geographical Society is full of most valuable papers. The first paper, "The Alpine Plants of Central Caucasus," by M. Akinfieff, is the result of seven years' work. Being unable at present to publish a further instalment of his 'Flora of Central Caucasus' (Kharkoff, 1894), the author now gives a list of the Alpine plants, 270 species, which were found at altitudes of 9000 feet and more. We have next three papers containing geographical descriptions and full statistical data relative to the Zakataly district and the provinces of Stavropol and Terek, as also a historical sketch of the Terek Cossacks and the towns of the Terek province. These four papers are real mines of information, and one of them is accompanied, moreover, by a map of the province of Stavropol (20 miles to an inch), showing the distribution of landed property among the peasants, the Crown, the domains, and private property. N. Vinnikoff gives next two most valuable lists of all trigonometrically determined points in the government of Kutais (446 points) and in the province of Terek (151 points). Their latitudes, longitudes, and altitudes are given, as well as an alphabetical list of the same points for purposes of reference. V.V. Markovich contributes an interesting paper on the forests of Ichkeria (in Daghestan), which well depicts the forests from the forestry point of view, their utilization, and their inhabitants. Colonel Kartseff contributes a paper on the Kurds—their numbers, their geographical distribution, their language, religion, and division into branches, their institutions, and their present conditions. A most valuable map of Kurdistan (33½ miles to the inch), showing the distribution of the Kurds, the Sunnites, the Kizil-bashs, and the Yezids separately, as also the Armenians and Nestorians, accompanies the paper. The most interesting map of this volume is certainly a map of Trans-Caucasia on a large scale, 13 miles to an inch, showing the division of the country into provinces, districts, cantons, and villages, as also, in different colours, the religions of the population in each village. The appendix contains a masterly paper, by N. Y. Dinnik, on the upper parts of the Urushten and Byelaya rivers, accompanied by a map of the region, on the scale of 3½ miles to the inch, and most valuable "Notes on Suanetia," by Raph. Eristoff (111 pages), which deals with the common law of the Suanes, the children's plays, the legends, the demonology, the beliefs and superstitions, the dwellings, and so on. On the whole, this is one of the best volumes of this remarkably good collection. The twentieth volume of the same publication again contains a work of great value. It is occupied entirely by a first instalment of a large work by Colonel V. Y. Lisovskiy, "Transcaucasia." This first instalment contains the physico-geographical description of the country—the mountains and plateaus; the rivers, lowlands, lakes, seas, climate, vegetation, and animals; a sketch of the origin of the Caucasus isthmus, and its mineral resources. An excellent map of the Caucasus, on the scale of 27 miles to the inch, in which special attention seems to have been devoted to orography, accompanies the very valuable work of Colonel Lisovskiy.

Limnological Studies in the Tirol.—Dr. Halbfass has lately contributed to *Globus* (vol. 73, p. 216; vol. 74, p. 18) some notes on recent studies of the lakes of the Tirol, taken chiefly from articles by G. B. Trener and E. C. Battisti in a new Italian serial published at Trient under the name "Tridentum." They relate chiefly to the lake of Terlago, which, as recently examined by the above-mentioned authors, seems in course of extinction, the maximum depth being now only 9·3 metres (30·5 feet), as compared with 13·8 metres (45·2 feet) recorded by

Damian in 1887 (cf. *Journal*, vol. i. p. 351), while other measurements show a similar decrease. This is due to the fact that the loss by the subterranean outlet (the lake lying in a *Karst* region) more than balances the supply of water by streams. It has been proved by the use of fluorescent liquids that the Ischia Podetti, a small stream which empties itself into the Adige, derives its water from a subterranean outlet of the lake. The results of soundings, temperature determinations, etc., are also given by Battisti with regard to the small lakes of the Fersina district, the most noteworthy point being the phenomenon observed in the Lago delle Valle di Fornace and the Lago Santo, of warmer water in the lower layers than at the surface, in spite of the fact that the lakes were frozen over. Battisti's explanation that this is due to hot springs can hardly, Dr. Halbfass thinks, hold good of the former lakes, where the warmer zone takes up the greater part of the lake.

Increase of the Po Delta during the Nineteenth Century.—Prof. Marinelli discusses the question of the progressive increase of the area of the Po delta in the *Revista Geografica Italiana* (1898, Nos. 1–3). Having, by a comparison of the Austrian map of about 1823 with the result of modern surveys carried out in 1893, arrived at the conclusion that the mean annual increase during those seventy years has been about ·762 sq. kilom. (·293 sq. miles), the author compares this result with those obtained earlier in the century by De Prony and Lombardini, the only observers who had previously studied the question in detail. This comparison leads at first sight to the conclusion that the rate of increase has varied greatly within the period for which data are available, Lombardini's estimate for the interval 1600–1830 having given an annual increase of no less than 1·35 sq. kilom. (·518 sq. miles). Of the causes which might be appealed to as an explanation of such variation, Prof. Marinelli rejects those connected with changes in the amount of rainfall, deforestation, etc. He is more inclined to give weight to such factors as the increased depth of the sea, and its more powerful degrading influence in proportion to the advance of the coast-line, or a possible subsidence, owing to the effects of sedimentation. But an examination of the data on which the estimates respecting the earlier periods are based, shows that no implicit reliance can be placed on these, for a very slight displacement of the position assigned to the coast at an early epoch would materially alter the proportionate increase before and after such date. Taking the mean of the rates of increase given by Lombardini for the periods before and after 1599, a result is obtained which differs but little from that arrived at by Marinelli for the present century, the slight decrease observable in the latter being easily accounted for by the causes above alluded to. The estimated total increase during six centuries amounts to 516 sq. kilom. (198 sq. miles), which means that, by the action of one river alone, Italy has in that period gained no less than $\frac{1}{500}$ of its previous area, while recent surveys show that the increase is actively maintained at the present day. At the end of his article, Prof. Marinelli gives some notes on the length of time which would probably be required to fill up the whole of the Northern Adriatic above 44° 45′ N. lat. The disposition now displayed by the mouths of the Po to bend in the direction of the axis of the gulf introduces a special element of uncertainty, but the writer considers that the time required would certainly exceed 100 centuries, and would probably be more than 120.

ASIA.

Journey in Northern Su-chuan.—A recently issued Consular Report, by Mr. G. J. L. Litton (Miscellaneous Series, No. 457), is of special value, as containing the account of a journey through some of the least-known parts of Northern

Su-chuan, with abundant details on the physical and commercial geography of the country traversed. Mr. Litton's route touched in places those of Count Széchenyi, Mrs. Bishop, and Captain Gill, but for considerable distances it led through entirely new country. Starting from Chungking, the traveller proceeded northwards by the "lesser north road" up the valley of the Kialing river. Beyond Ho Chau, the great treeless sandstone basin of Su-chuan was reached; it is subject to a tremendous heat, and has a poor soil, rice being grown only in the low gullies, yet the population is swarming, every inch of available ground being cultivated. The country to the east of the Kialing was the scene of the famine of 1896–97, and Mr. Litton remarks that these districts are so over-populated that even a slight failure of crops will in future entail widespread distress. The estimate of 50,000,000 for the whole of Su-chuan is, in his opinion, quite a possible one. Beyond Paoning (visited by Mrs. Bishop), the hilly country of North-Eastern Su-chuan, inhabited by a maize and wheat-eating population, begins. Low ranges branch off from the main range which divides Su-chuan from the provinces to the north-east, traversing the country from north-west to south-east, and the country produces little except the teas of Tai Ping and the salt of Ta Ning. At Kwang Yuen, situated on the Kialing, in a hollow among the mountains, the main Peking-Chengtu road, followed in part by Széchenyi, was struck. This place does an important trade with Kansu, a second road leading hence to Chin Chau and Lan Chau. The chief object of commerce is the "water" or Lan Chau tobacco, but fine sheepskins also come down from Chin Chau, one of the most important centres for this trade in China. Fifteen miles west* of Kwang Yuen the Pai Shui or Pi Kau joins the Kialing, and up its valley, hitherto, we believe, undescribed by Europeans, Mr. Litton proceeded. On entering the gorge of Shi Kuan Tsu—the first of a series which extends beyond the market town of Pi Kau, a limestone region is reached; the stream is little more than a mountain torrent, and traffic is carried on chiefly by a rough and narrow track through a wild and thinly peopled region. Pi Kau derives its importance from the medicine trade, standing at the junction of several mountain tracks from the north and west. It is in Kansu, the southern parts of which might, if immigration were encouraged, supply greatly increased quantities of wheat, hides, medicines, etc. Mr. Litton was prevented by illness from making an extended tour into that province, turning instead south-west towards Lung An. Before re-entering Su-chuan, the central mountain range has to be crossed by the Ta Tao Ling pass (6150 feet), the ascent to which is rough and difficult. On the Su-chuan side the cultivation is entirely maize. At Lung An Mr. Litton struck Captain Gill's route, skirting the great mountain system of North-West Su-chuan to Sungpan on the upper Min river, and then proceeding southwards down the valley of the latter. He speaks with enthusiasm of the scenery and the attractions which the country has for the naturalist, and gives useful details of the trade of Sungpan, and the non-Chinese population of its neighbourhood. The mountain region to the south of the Lung An—Sungpan road is inhabited by Chinese or Chinese-speaking Man Tsu. The population is, however, sparse and of recent origin, and large patches of virgin forest still remain. At Mao Chau Gill's route was left, and the south of the hill country crossed by a track leading to Chungpa and the Chengtu road. Here again Mr. Litton was on new ground, and his observations on the country and people are of much value. His report concludes with notes on the Chengtu plain and its irrigation, on the prospects of foreigners in Su-chuan, and on silk production.

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* The direction is given on Kreitner's map (Széchenyi Expedition) as S.S.W.

AFRICA.

Surveys in Buddu, Koki, and Ankole.—In a letter dated Buddu, April 18, 1898, Lieut. Hobart, one of the officers on military duty in Uganda, gives some details respecting surveys carried out by him in the districts to the south-west of that country, accompanied by a map. His routes have intersected Buddu and Koki in all directions, and many minor corrections and additions have resulted. The most important is the insertion of a new Lake, some 14 miles by 3, which drains to the Victoria Nyanza by the Kibale or Kiwale river, just north of the Kagera. The lake lies due north and south, and is named by the natives Kachera, but its discoverer has named it Hobart. A lake, Kanyete or Kachera, was shown by Lugard, who, however, did not visit it, and according to Lieut. Hobart there are two distinct lakes of those names, as well as one named Kajanabátola (Villiers), which means "It comes as you look at it," and refers to the sudden rise and fall of its level, due apparently to subterranean action. Lieut. Hobart says that the Germans have since 1894 occupied the district of Kibumbiro, part of which lies north of 1° south, and therefore properly falls outside their sphere. He urges that the Kagira (Kagera) is the natural boundary of Uganda, and speaks of a current said to set across the Victoria Nyanza from its mouth towards the Victoria Nile. It is known to the natives as Kiira, practically identical with the name of the river.

The Sulphur Springs of Amboni, German East Africa.—In the *Deutsches Kolonialblatt* for May 16, Herr Bornhardt gives a short account of the sulphur springs which have been discovered on the banks of the Sigi, a small river debouching into Tanga bay, and which have been thought capable of utilization as a curative agent. The writer describes the geological features of the neighbourhood, and discusses the probable origin of the springs and the means which might be employed to make use of them for baths. At the point where they occur, the Sigi has cut itself a deep channel through the limestone rock, which ends here as an eastward-facing escarpment. The most copious spring occurs on the left bank at the mouth of the gorge, issuing from a field of piled-up blocks at the foot of the cliff. The level of the river varies considerably, according to the season and the state of the tide, the fresh water being impounded at high tide, though no salt water reaches the spot. The springs are situated at about mean water-level, being completely covered at times. Herr Bornhardt considers that the spring water is collected by the limestone and overlying strata of sandy clay, but is of opinion that the sulphur is obtained from other strata of Jurassic age (marls, clay-slate, etc.), which come to light on a tributary of the Sigi, and have been found to contain concretions of iron pyrites. The broken nature of the limestone formation will render doubtful the success of any efforts to raise the level of the spring-water by dams. At low water, however, it might be utilized at its present level by the excavation of a basin, while at high water it would have to be raised by pumping. A sketch, showing the position of the springs, accompanies the article.

Lieut. Werther's Explorations in German East Africa.—The expedition carried out by Lieut. Werther in 1896–97 to the northern parts of German East Africa, between Masailand and Unyamwezi, has already been briefly alluded to in our pages. The cartographical results have now been published in *Petermanns Mitteilungen* (1898, No. 4) on the scale of 1 : 750,000, accompanied by a general description of the country traversed; and as Lieut. Werther's routes (including those of his former journey in 1893) have intersected the country in all directions, he is able to give, from personal knowledge, a very complete account of its orographical and other features. The Nguru, Usagara, and Rubeho mountains form, in his opinion, a connected system, almost all the streams from which belong

to the basin of the Wami. On the east side of the mountains rain falls throughout the year, so that the streams never dry up; but the western side, as is the case with other mountain groups in this region, is much dryer. The Wami or Makata plain to the south has quite a different character from the country to the north, though both often go by the name of steppe. The former is quite level, and is in great part overflowed during the rains, while the latter—the Masai steppe—has an undulating and broken surface largely covered with grass. Another mountain system is that of Irangi, which formed the primary objective of the expedition. Its general direction is north-east, and it is drained by tributaries of the Bubu, which finally loses itself in a salt swamp in the west of Ugogo. The streams have wide sandy beds, dry at the surface except after rain. Further west we come to the long line of escarpment which constitutes the western edge of the great East African trough. The eastern edge seems to be by no means well marked in these latitudes, and the character of a trough is not always preserved. Besides Lake Manyara, a large number of brackish lakes and swamps occur near the foot of the escarpment; one of them, named Balangidda (about 8 miles by 3½), had not been visited by any other European. Their depth even in the rainy season seems hardly ever to exceed 6 feet, whilst in the dry season they leave a crust of salt mixed with soda. In the centre of Ufiome rises the three-peaked Gijeda-sen, apparently an extinct volcano; both the mountain itself and the whole volcanic district round abound in iron. Further south, and closer to the escarpment, lies the old volcano Gijeda-hanang, or Gurui, which Lieut. Werther ascended. It has a vast crater in the form of a horseshoe, the sides of which slope very steeply both outwards and inwards. West of the escarpment lies the high plateau of Turu, Ussure, and Iramba, in great part covered with bush-forest, and to this succeeds the Wembere steppe, a longitudinal depression running from south to north and north-east, and generally bounded by well-marked walls. Besides Lake Nyarasa (the Eiassi of Baumann) in the north, there is an extensive swamp, filled in the rains, towards the south. In about 4° S. lat. the steppe sends out a wide bay to the west, while to the east rise the much-rifted Isanzu mountains. Still another trough occurs between Lakes Nyarasa and Manyara, or Laua-ya-Mueri. This is the depression in which lies Lake Hohenlohe, discovered by Lieut. Werther in 1893, and which proves to be not a circular hollow, as he then thought it. The bordering heights increase in altitude towards the north-east, those on the eastern edge being the higher; they have a heavy rainfall, and some primeval forest occurs in clefts on their sides. In the wooded region between Lakes Hohenlohe and Nyarasa dwell the Watindiga, a hunting tribe.

Explorations in the Congo Basin.—Although no very important discovery remains to be made in the Congo basin, minor additions to our knowledge continue to be made in various parts. The results of some of the latest explorations in the basin of the Kasai and its affluents are embodied in Sheet ix. of M. Wauters' map of the Congo State, given with the *Mouvement Géographique* for April 24 (No. 17, 1898). A short account of the explorations appears in No. 16 of the same journal. Early in 1897, M. Stache explored the lower course of the Loange, which joins the Kasai from the south, a little below the mouth of the Sankuru. Report had it that the stream was inaccessible owing to its sandbanks and violent current, but M. Stache found that the difficulties had been much exaggerated. It is a fine stream with deep water and a mean breadth of 200 to 250 yards, with wider reaches exceeding 600 yards. It has a very rapid current in places, but is navigable for large steamers. Its banks are comparatively high, without forests, but generally sprinkled with wine-palms. The Kancha, which enters the Kasai some 80 miles lower down, flows through low plains, and its waters are black, deep, and easily

navigated. The population of its banks seems extremely dense. The sixteenth number of the *Mouvement* also contains the first of a series of articles by Lieut. Gustin, who was attached to Van Kerchhoven's expedition of 1891–93 to the upper Welle, accompanied by a map of that river, on which his various routes are laid down. In the seventeenth number, M. Wauters makes some remarks on the hydrography of the region between the Mobangi and the Shari. On the publication of the results of M. Clozel's journey, M. Wauters expressed a doubt as to the connection of the Wom, discovered by him, with the Shari basin. He now points to a recent exploration by M. Perdrizet, as tending to prove that the Wom is identical with the Ombela, a tributary of the Mobangi. In the *Comptes Rendus* of the Paris Geographical Society, however (1898, p. 241), Dr. Herr, M. Clozel's second in command, contests this theory, pointing out that the Wom, after flowing south-east for a short distance, was found by M. Perdrizet to resume its easterly course, and probably turns to the north after reaching the end of the Kare range, supposed by M. Wauters to form part of the Congo-Shari water-parting. The Ombela, Dr. Herr shows, was found by Porel and Brunache to be quite a small river. Finally, it may be noted that since last September commercial enterprise has been initiated on the Lomami, hitherto the most neglected of the Congo tributaries. Factories have been founded on the lower part of the river by M. Langheld, who reports that the population is far more dense than was previously stated, the natives being of an unusually fine type, and well-disposed to Europeans. A company has been formed to open up the region to trade.

Von Carnap's Expedition from the Cameroons to the Congo.—A letter from Lieut. von Carnap, published in the *Deutsches Kolonialblatt* for May 16, supplements to some extent the account of his journey given by the *Mouvement Géographique* (*Journal*, vol. xi. p. 551). The exact route of the expedition cannot, however, as yet be followed on the map. From Yaunde, Von Carnap made his way first towards the north-east to the town of Yoko, in Southern Tibati, proceeding thence south-east in order to visit the important trade centre of Wuchaba. His further route seems to have led along the upper Sanaga, almost to the latitude of Ngaundere, before again bending southwards. The reason for this northerly *détour* was the difficult nature of the country south-east of Yaunde, which is said to consist of an extensive primeval forest. Even on the route followed great hardships were experienced, the native porters suffering especially from the cold. A little later in the year the south of Adamawa would have been impassable, on account of the amount of water. Hausa caravans traverse this region from Yola in the north, and from French Congo in the east, proceeding by various routes to Yoko and Wuchaba already mentioned. Arrived at the French post of Carnotville, on the Mambere, Lieut. von Carnap sent back the greater part of his force by a more direct route to Yaunde, under sub-officers Staadt and Zampa, while he himself proceeded to the south-east corner of the German territory, at the junction of the Ngoko and Sanga. The Dutch and Belgian trading-stations on the Ngoko lie at present on the right bank, but the chief trade is done with German territory, owing to the immense amount of ivory supplied by the forest region between 2° and 4° N. lat. The supply will probably last for a number of years, but Lieut. von Carnap urges that attention should be paid to rubber, which he observed everywhere in large quantities. Some further details respecting the earlier stages of the expedition appear in the issue of the *Kolonialblatt* for June 15.

AMERICA.

Exploration of the Upper Amazon Tributaries.—Dr. A. Rimbach contributes to the *Zeitschrift* of the Berlin Geographical Society (1897, No. 6) a

detailed account of a journey made by him in 1894, accompanied by his brother, Carl Rimbach, to the upper Amazon, for the purpose of studying the physical features, and especially the vegetation, of some of the less known parts of that region. Starting from Cuenca, between the two main chains of the Andes of Ecuador, the travellers first proceeded northward to Riobamba, near the headwaters of the Pastaza, it being their object to descend this little known stream to its confluence with the Marañon. Between the basin of Cuenca and that of Riobamba, the Azuay range (14,700 feet, andesite) had to be crossed, and Dr. Rimbach gives some interesting notes on the character of the vegetation at different altitudes, and on the varying aspect of the Andean ranges visible during the journey. The route to the Marañon *viâ* the Pastaza was used by the missionaries of Quito in De la Condamine's time, and was even followed by Madame Godin in 1769 on her adventurous journey to join her husband, one of the French astronomers who took part in the measurement of the degree in the equatorial regions of South America. It appears to have fallen into disuse of late years, and the path to Canelos, a mission station on the Bobonaza, was so indistinct as to be missed even by Dr. Rimbach's guide, who had often traversed it before. The passage of the eastern cordillera is made by a deep cleft at the northern foot of the volcano of Tunguragua, on the slopes of which the travellers could distinguish the lava stream due to the eruption of 1886. At the village of Baños, within the pass, the travellers found the inhabitants much exercised in mind on account of the Peruvian encroachments, and were taken for spies of that nation. Soon after passing this the vegetation characteristic of the Sierra was replaced by forest, which, however, did not at once assume the moist tropical character typical of the lower regions. The numerous tributaries of the Pastaza mostly emptied themselves into the main stream by waterfalls from small plateaux, which are chosen as the sites of settlements. At Canelos, the travellers were detained some weeks by swelling and ulceration of the feet, due to the long marches through the forest. The route was continued by canoe down the Bobonaza and Pastaza amid incessant rain, which caused the river to rise rapidly, flooding its low-lying banks, and bringing down trunks of trees in dangerous quantities. Below the village of Andoas, at the mouth of the Bobonaza, the banks of the Pastaza were quite uninhabited, except at two spots where Peruvian rubber collectors had settled. One of the Indians of the party having been bitten by a poisonous snake, Dr. Rimbach allowed his escort to return, while he and his brother continued the canoe voyage alone, finally reaching the Marañon, and continuing down that stream to the station of Parinari. A compass survey of the Pastaza was carried out, and its course as given by Dr. Rimbach, differs considerably from that shown on the maps. A sketch of the complete river system of the northern tributaries of the Marañon, based on Dr. Rimbach's observations and inquiries, accompanies the paper. The Marañon, too, was found to be much swollen at the end of May, the chief period of high water lasting from February to May, while a smaller rise takes place in October and November. After exploring the banks of the Samiria, a small stream which enters the Marañon just below Parinari, the travellers proceeded by steamer to Yurimaguas, on the Huallaga, and thence by land to the coast *viâ* Moyobamba, Chachapoyas, and Cajamarca. This route involved the crossing of five high ranges, and gave many opportunities of studying the varying aspects of climate and vegetation in Northern Peru. The forest region which had continued without intermission since the descent from the highlands of Ecuador ceased near Moyobamba, the western slopes of the cordillera east of that place showing a tendency to a xerophytic character. On both branches of the central cordillera the contrast between the moist vegetation of the eastern, and the dry vegetation of the western slopes is most marked, while on both branches of the

western or coast cordillera the dry predominates. The peculiar character of this dry vegetation, consisting largely of cacti, was especially noticeable on the sides of the upper Marañon valley. The descent down the heated, waterless, slope occupied nearly a whole day, after the stream had been first sighted.

New Expedition of Dr. Hermann Meyer.—Like his brother, Dr. Hans Meyer, Dr. Hermann Meyer has lately undertaken a new expedition to the scene of his former explorations. It is announced in *Globus* (vol. lxxiv. p. 20) that he is to start during August for South America, where he hopes to explore the Atelchu, one of the Xingu headstreams, discovered by him two years ago. There are still unvisited tribes of Indians on this river, and Dr. Meyer hopes to obtain valuable ethnological results. Three other Europeans are to accompany the traveller.

Sir Martin Conway's Expedition.—Sir Martin Conway has left for Bolivia for the purpose of exploring the high group of the Andes, containing the peaks Illimani and Illampu (Sorate).

AUSTRALASIA AND OCEANIC ISLANDS.

Prof. Haddon's Expedition.—According to news received at Cambridge from Prof. Haddon, the expedition which went out under his leadership to study the anthropology of Torres Straits and other parts of the Eastern Archipelago arrived at Thursday island on April 23. A week later a start was made for Murray island, which was, however, only reached after a week's trying navigation. The expedition took up its quarters on Murray island in a deserted mission house, and work had begun in earnest. Preparations are being made by Rajah Brooke to afford the party every possible assistance on their intended visit to Borneo.

The Island of Rotuma.—Mr. J. Stanley Gardiner in his paper on the "Geology of Rotuma" (*Quarterly Journal of the Geological Society*, vol. liv. part i.), treats at some length on the topography of the island. The author's notes were made during his visit to the island in the months September to December, 1896. The island of Rotuma is situated in lat. 12° 30′ S. and long. 177° 1′ E. It appears to lie on a great submarine plateau which includes the Tongan and Fijian groups, and which has a northward extension of 4° to 5° of latitude, with a depth not greater than 1500 fathoms in a general depth of 2000 to 3000 fathoms. The breadth of this plateau north of, and including Tonga, is about 10°, while in lat. 9° to 13° S., it has a westward extension to join the plateau on which the Santa Cruz and Solomon groups lie. Rotuma consists of two parts joined together by a narrow neck of sand. The eastern end is about 5 miles long by 2½ broad, and the heights of its hills, which are volcanic in character, vary up to 860 feet. On their outer faces, towards the sea, are extensive beach-sand deposits. The western end is very sharply separated from the beach-sand flat at the isthmus by steep cliffs of 70 to 100 feet, surrounding the base of Kugoi, while the same hill continues to the south into Kiliga, but to the north has a sharp drop into a valley, from which Sororoa rises to the height of about 850 feet. A remarkable cavern in the lava of Sol Mafiri, with lava stalactites is described, as also a similar cavern in An Hufhuf. The total annual rainfall of the island is estimated at from 150 to 250 inches. The author is of opinion that Rotuma was first formed of a kind of basaltic rock, such as is found in Kugoi now. This rock he believes to have extended along the whole island as it now runs, but to have been broken up by that great eruption, or series of eruptions, which formed the central U-shaped range of hills of the eastern end. By this eruption he believes that this basaltic rock was in places loosely piled up, and then, by disintegration and admixture with lava, formed the hills and islands of volcanic ash. The last stage is the washing away of these, and the formation of the coral-reef and the beach-sand flats.

POLAR REGIONS.

Drift-casks for the Investigation of Polar Currents.—In the *Bulletin* of the Geographical Society of Philadelphia (vol. ii. No. 3), Commodore G. W. Melville, well known from his participation in the ill-fated *Jeannette* expedition, develops his plans for an investigation of the circumpolar currents by means of drift-casks. His proposal is that a number of oaken casks of a special design shall be constructed and set adrift to the north of Bering strait in sets of five. The shape suggested is that of parabolic spindles, conical at the ends, the material to be of sufficient strength to withstand heavy pressures. They would be provided with the ordinary bung-hole and bung, the intention being to place within each a tightly corked bottle for the preservation of records in various languages, giving details regarding the exact position in which the casks were abandoned, and requesting the finder to communicate with the hydrographical office of the country to which he may belong. The first five casks might be set adrift at or near Herald island, and the rest successively to the northward, along the eastern edge of the polar pack, until about lat. 75° N., long. 170° W. were reached. A map is added showing the probable lines of drift across the polar basin, one, in Commodore Melville's opinion, probably bending to the east, towards the American archipelago.

Departure of Lieut. Peary's Expedition.—The departure of the *Windward* from New York for the North Polar region took place on July 2. On July 9 the ship reached Cape Breton, where Lieut. Peary had arranged to embark, and at once proceeded to coal. An early start northward was expected to be made, the ice in those regions being reported unusually favourable for the time of year. The *Hope*, with coal and other supplies, had sailed previously, and was to meet the *Windward* in the north of Baffin's bay. In accordance with the programme already made public, Lieut. Peary will probably be landed at Sherard Osborn fiord, the ship then returning home if not caught in the ice. In the case of favourable ice-conditions, however, it is possible that he may steam still farther northward before landing. He hopes to reach the northernmost point of Greenland early in the summer of 1899, and to push on for the pole with a small and compact party during the same season.

Mr. Wellman's Expedition.—Mr. Wellman writes to us from Archangel under date July 4, announcing the immediate departure of his expedition for the north. The *personnel* consists of nine in all, four from America, and five from Norway, whilst eighty-three Siberian dogs have been taken on board. A Reuter telegram from Vardo, dated July 15, announces the return thither of Mr. Wellman after a preliminary cruise to the north, heavy pack-ice having been found to bar the way in 77° N. A renewed start was to be made on the 17th. The unfavourable ice-conditions this summer in the Spitsbergen seas are also referred to in *Globus* (vol. 74, p. 18).

Australasia and Antarctic Exploration.—With a view to arousing interest in antarctic exploration in the Australasian colonies, the Hon. C. C. Bowen, who, as a member of the New Zealand Legislature, was present at the Antarctic Conference held last summer at the Society's rooms, has written an article on the subject, which has been published in the *Press* of Christchurch, New Zealand (May 16, 1898). After recounting the various attempts which have been made within the last ten years to set on foot a British expedition to the Antarctic, and lamenting the apathy shown by the Australasian colonies, Mr. Bowen proceeds to sketch the past history of south polar research, as he believes that ignorance of what has been done so far, and of the important problems awaiting solution, is the real cause of the little interest displayed by the colonial public in the matter. Some effect seems to have been produced already by Mr. Bowen's article, which has been reproduced, in whole or in part, in other colonial papers.

Mr. Borchgrevink on his Expedition to the Antarctic.—At the closing meeting of the session Mr. Borchgrevink spoke a few valedictory words on the eve of his departure for the Antarctic, and gave some details as to the composition and objects of his expedition, the funds for which, as is well known, have been provided by Sir George Newnes. Mr. Borchgrevink is accompanied by a strong scientific staff, including Captain Kolbeck and Mr. Louis Bernacchi as magnetic observers, the latter being also an expert photographer; Herr H. Klövstad, M.D., M.A., of Christiania University, as medical officer; and Messrs. N. Hansen and Hugh Evans as zoologists. His ship, the *Southern Cross*, is commanded by Captain Bernherd Jensen, who has already sailed in the antarctic seas, and there are two mates and a crew of twenty-four. Mr. Borchgrevink expressed his sense of the honour which has devolved upon him in being permitted to continue the work of the illustrious Sir James Clark Ross, and his satisfaction that any prospective results will be achieved under the British flag. He expects to return in 1900.

OBITUARY.

Major-General R. G. Woodthorpe, C.B., R.E.

By Colonel Sir Thomas Hungerford Holdich, R.E., K.C.I.E., C.B.

Robert Gosset Woodthorpe, second son of Captain John Bolton Woodthorpe, R.N., was born at Purfleet, in Essex, on September 22, 1844, and was educated at Mr. John Taylor's school at Woolwich, preparatory to entering the Royal Military Academy as a cadet. He obtained his commission in the Royal Engineers on June 22, 1865, and very early in his career he elected for service in India. He "heard the East a-calling," as many others have done, and he responded to that call with the service of a lifetime, finishing his career as Deputy Surveyor-General at Calcutta, and taking his last long leave on May 26.

Nature intended Robert Woodthorpe to be one of the world's explorers. He was gifted with a short, square figure and sturdy frame, immense capacity for endurance, and a courage that no combination of difficulties and dangers could depress. Thus, when the Indian Survey Department pointed the way to geographical distinction, he accepted the chance with alacrity, and was speedily drafted off to some of the wildest and most inaccessible districts of the Indian borderland on survey duty.

His first surveys were carried through the Khasia and Naga highlands, and it was here that he found himself face to face with a people so exceptional in their physical characteristics, and so entirely aboriginal in their manners and customs, that he at once fell into the habit, which never after left him, of illustrating his wanderings with his pencil. As an amateur artist he was of far above average capacity, and his pictorial records of the Eastern frontier must be considered unique in value, not only for the extent of them, but for their minute accuracy, and the patient, painstaking care with which comparatively small ethnographical traits and distinctions are preserved in them. It was a life of adventure and danger that he led, even in those early days. He was with Butler when that intrepid officer was killed by a spear launched from the jungle, which was apparently intended for Woodthorpe himself. Indeed, his records of the Khasia survey alone would fill a book with stories of adventure; but survey officers in India have little time for book-writing, and the world hears little about them. In 1871–72 he was called to accompany the Lushai expedition, which was carried through districts much akin to those of the Khasia community. Here again his

pencil came freely into play, and of this particular expedition he did publish an account, which is well worth study.* Here, too, he first made the acquaintance of an officer who had been appointed quarter-master general of the force—Colonel Roberts, V.C.—and the friendship thus inaugurated lasted unbroken until Colonel Roberts became commander-in-chief of the Indian army, under a much more imposing title.

Not long after the Lushai expedition (in the late autumn of 1878), the outbreak of war with Afghanistan gave Woodthorpe another opportunity of exhibiting his peculiar qualifications, not only as an explorer and surveyor, but as a hard fighting and determined soldier.

Captain Woodthorpe was placed in charge of the survey party attached to the Kuram column under General Roberts. The geography of Afghanistan was in those days mostly an unravelled mystery, and the art of carrying on a systematic survey with a moving force in the field was an art which was then in its infancy. Woodthorpe effected on the line of the Kuram what Tanner and others accomplished on the Khyber. The field work which fell to him was both incessant and rough, demanding all the physique of a trained mountaineer, added to the skill of a trained triangulator. On one occasion I remember that there was question of reaching the highest peak of the Sufed Koh range (Sikarám) from a position near the Shutar Gardan pass, in time to admit of a day's work with the theodolite before descending again to camp ere night fell, on a short winter's day. The ascent was one of about 7000 feet, four hours were barely sufficient for the observations, and the descent had still to be included in the ten or twelve hours of daylight that was all that could be reckoned on. At the first attempt Woodthorpe was up to time, but his carriers were not; he had found the way up, but they could not follow him. He punished them all for laziness, and started again with the same men a little earlier next day. This time he scored a complete success. In those days he was occasionally accompanied by another enthusiastic mountaineer, one who was kind enough to assist him in keeping the record of his observations. I lately found some pages of his "angle books" signed by "George White, Major 92nd Highlanders." In fulness of time this gallant officer and most capable climber of high places succeeded Lord Roberts as commander-in-chief in India. But Captain Woodthorpe had his turn of fighting too. He was acting as aide-de-camp to General Roberts during the memorable Peiwar Kotal action, when he unwittingly made a most risky mistake. In taking a short cut back to the staff from some remote corner of the field, he jumped straight into an Afghan sungur, under the impression that it was held by our own troops. Fortunately, he was himself wearing our Afghan pugri at the time, and he recognized his error just a second or two before the Afghan defenders recognized the quality of their casual visitor. Those few seconds gave him a few yards' start out of the sungur again; but a shot at close quarters caught him in the back, broke his revolver, travelled round his ribs, and bowled him over as he retired hastily down the hill "like a rabbit," as he said. But he was none the worse for it! He lost his rifle, but recovered it again a few days afterwards, during the general Afghan retreat. His work in the Kuram earned him a brevet majority, and when the second phase of the war broke out after Cavagnari's massacre, he was again to the front on the same line of advance, and under the same general. This time we worked together (I had previously been on the Kandahar line) after we had joined our respective surveys at a point on the Bala Hissar hill, overlooking the city of Kabul. During the memorable winter which followed Woodthorpe and I shared our quarters in

* 'Account of the Lushai Expedition, 1871–72.' Hurst & Blackett.

the "72nd" gate at Sherpur with a brave soldier (Stratton), who was subsequently killed in action; and it was whilst the siege of Sherpur lasted that I had the opportunity of watching and admiring the unfailing cheeriness and unflagging

GENERAL R. G. WOODTHORPE, C.B., R.E.

determination that Woodthorpe evinced in his laudable efforts to "keep things going." Whether they were things professional, theatrical, or social; whether there were amusements to be promoted amongst the men, or conviviality to be shared amongst their officers, Woodthorpe was in the thick of them all.

I have referred to his undaunted pluck. If the quality of courage is one that admits of many varieties, then I can say with confidence that Woodthorpe possessed them all. He was of the stuff that makes V.C. heroes, though he never won that distinction. I watched him once when he was within a measurable distance of it, but on that occasion the race was to the swift, and he just failed to win. It happened thus. I had taken a powerful survey telescope to the top of that Sherpur gateway on which General Roberts was watching the progress of the fighting on the Asmai hills before him. The distance was too great to distinguish the different regiments with the naked eye, but near enough to admit of recognizing individuals with a good telescope. So I reported progress, whilst the general walked up and down the narrow space of the roof. I watched a cloud of skirmishers (72nd and Guides) struggle up the heights held by the enemy, till they appeared on the sky-line, where they broke right and left to clear the ridge. I knew that Woodthorpe was with them, and was certain that he would be in the first flight. On the left, balanced on the very apex of the mountain, was a stone-built sungur, from which the plucky defenders declined to move. I could watch them waiting and reserving their fire to the last, meaning to die (as they did die), every man of them, where they stood. In front of the sungur, flat against the sky-line, was 50 yards or so of open sward; at the end of this a rocky bit of cover. Gradually behind the cover a little band collected, and I waited, with intense expectancy, to see who would be first over the flat and into that sungur. It was a gallant corporal of the 72nd who first broke away from the cover of the rocks. He was speedily followed by a small group, headed by the easily recognized figure of my chum. But he was a second or two too late this time. Corporal Sellar was not to be caught. He reached the foot of the sungur first; and then there appeared on the crest of it a figure which seemed gigantic, as, with flowing robes streaming in the wind, and uplifted arms, he dashed down a heavy stone on to the luckless corporal, and sent him, doubled up in a heap, many yards down the hillside. What followed I did not see; but every Afghan died a soldier's death, whilst Corporal Sellar picked himself up and won a soldier's reward—the Victoria cross. More than once have I discussed this little episode with Woodthorpe, and he admitted that for once he was thoroughly exhausted. During the fighting that took place round Kabul, whilst that never-to-be-forgotten December dragged on, Woodthorpe was always to the front, and once had his clothes torn by a bullet and was again slightly wounded, but he was never ill, and never lost that contagious cheeriness which lightened those gloomy days like sunshine. A well-deserved brevet lieut.-colonelcy rewarded him for his share in the second phase of the Afghan campaign.

There are people who maintain that physical courage in action is a useful idiosyncrasy much to be encouraged amongst soldiers, but that it fails to prove the existence of any moral force of character; so I will add another little story.

Woodthorpe was alone this time—alone and deserted by most of his servants in a pestiferous jungle—when cholera gripped his camp. There was no sustaining excitement now, and he feared cholera personally with a deadly fear. There was no doctor, and he could get no assistance, so he worked by himself amongst his dying coolies; and if he could not stay the terrible enemy, he waited till the end, and then sewed the bodies up in coarse sackcloth *with his own hands*, and buried them. Dead or alive, he would not desert his coolies, and yet it is not too much to say that they were drawn from the scum of Assam. He "funked" the cholera, as he said, and of course he got it. Having got it, he told me that he funked it no longer—and he got over it.

It is impossible to write the life-history of a man whose whole career was one of incident and adventure within the short limits that are suitable to this journal; but I must include an account that has been sent me by Colonel Macgregor, C.B., D.S.O., referring chiefly to Woodthorpe's work on the Assam and Burmese frontier. Colonel MacGregor writes as follows: "Early in 1875 we were associated together in the expedition against the Eastern Nagas, to the south of Jeypore, on the left hand of the Brahmaputra river. These hill men had treacherously attacked a survey party under Captain Badgely and Lieut. Holcombe, killing the latter, and severely injuring the former. In this expedition Woodthorpe was ever to the fore, fighting, reconnoitring, and engineering, and in the taking of the enemy's position at Ninu Niau and Sannoa, was of the greatest assistance to the commander of the expedition (the late General Sir J. M. Nuttall, K.C.B.). I well remember how ready he was to share the contents of his water-bottle with me (when I had finished mine) in many a steep climb, and in this, as in numerous other ways, he showed his unselfishness and kindness of heart. In the cold season of 1883–84 Woodthorpe was employed in the Aka expedition to the north of Tezpur, on the right bank of the Brahmaputra, and was of the greatest service to General R. Sale-Hill, C.B., who acknowledged his indebtedness very handsomely in his despatches. On one occasion I remember seeing Woodthorpe cross over, by himself, the Maj Boreli river by means of an Aka cane cradle bridge in order that he might reconnoitre the opposite bank. It was a most risky thing to do, but "little Woodthorpe" never paused to count the cost before executing any deed of daring. In the Aka expedition I had the pleasure of accompanying him in all his reconnaissances, and we had very exciting experiences. Once (it was New Year's Day) we had two Gurkhas with us, and one had been shot in the neck by an (aconite) poisoned arrow. Woodthorpe scooped out the place with his pocket-knife and sucked the wound, and said, 'We will see the wounded man through the business' (after a hand-grip we heard the Akas yelling in the wood round us, and thought it was nearly 'all up'). Woodthorpe disposed our little party of four behind two trees, and we awaited the expected attack; luckily for us probably, the hill men thought better of it and dispersed. On another occasion Colonel H. St. P. Maxwell, C.S.I. (the political officer), Woodthorpe, and I were ascending a hill in single file, when we heard Akas above us cutting away at the canes and creepers which held together a 'shoot' of rocks. Woodthorpe dashed by me up the mountain-side with the view of stopping the cutting and saving our party, and he succeeded in doing so. In the winter of 1884–85 Woodthorpe explored the country to the south-east of Sadya, in the Upper Assam, and I had the good fortune to accompany him. We followed the course of the Noa Dihing, and then struck across the mountains (where, at an altitude of nearly 10,000 feet, we had to wade through snow), and, descending with four Gurkhas into the fertile valley inhabited by the Bor Kamptis, finally reached the Namkiu (the western branch of the Irrawadi), and Woodthorpe practically settled the much-vexed question of the source of the Irrawadi river (though some of the admirers of the intrepid traveller Prince Henri of Orleans afterwards gave the prince the entire credit of discovering the source, because he had crossed the eastern branch of the river). Woodthorpe's party eventually returned to Assam over the Patkoi range to the north-east of the Hukong valley, after many privations and hardships. Woodthorpe was ever cheery and hearty, and difficulties with him disappeared as if by magic almost as soon as they arose. On one occasion we were 'brought up' sharp by a swollen river running deep and rapid. Under Woodthorpe's supervision, we made a raft of plantain trees with creepers to lash the raft together (the only material available), and crossed over our little party without loss, though the Gurkha soldiers and Khasiâ coolies

were weak and faint (having had no food for nearly two days!). Woodthorpe took the raft across himself every trip (only one passenger could go at a time, as the plantain trees were so heavy and sunk more than a foot under water), and, as usual, worked like a Trojan. On another occasion he made us fell a tree across a deep and rushing mountain torrent, and, rigging up a hand-rail of cane, we crossed safely. Once we were very hard up for food, and saw no prospect of obtaining any. Woodthorpe recollected he had a few dynamite cartridges, so he went on a river in a little Berthon boat, and, exploding the cartridges by the aid of some Bickford's fuses, obtained a plentiful supply of fish, and so saved the situation. I could quote very many instances of the skill, readiness, pluck, and resource of my friend, and it gives me now the greatest pleasure to look back upon the happy and exciting times we have had together.

Colonel H. Godwin-Austen, F.R.S., in his paper read before the British Association at Aberdeen in 1885, on Woodthorpe's expedition from Assam to the Irrawadi, said, "Colonel Woodthorpe possesses all the qualifications that make the successful explorer. Great powers of endurance and observation, zeal for his work, brave but cautious, a talented draughtsman, and last, but not least, the tact to make himself liked by the people of the country." Colonel Sir H. Yule, in the discussion that followed the reading of my paper in 1886 on Woodthorpe's expedition before the Royal Geographical Society, said, "I am delighted to hear the testimony which Major Macgregor has borne with regard to his fellow-traveller, Colonel Woodthorpe, an officer with whose remarkable enterprises I have been much impressed for the last seven or eight years. Colonel Woodthorpe has made several remarkable journeys to the north-east of India; but his explorations have not been confined to that region. He has just returned from a journey in the extreme north-west beyond the British frontier, through passes which have never before been trodden by any European (exploration beyond Gilghit with General Sir William Lockhart). Colonel Woodthorpe has been an explorer in the regions of the sources of the Irrawadi and of the Oxus." On the same occasion, General J. T. Walker (late Surveyor-General of India) said, "Colonel Woodthorpe is one of the ablest and best officers in a department which contains many and excellent men."

In 1885–86 he followed the fortunes of an officer (Sir William Lockhart, who will shortly return to India as the third commander-in-chief, whose friendship and regard Woodthorpe had the good fortune to win) in the hazardous opening-up of friendly tribal relations, and the exploration of routes north of Chitral during the progress of the Afghan Boundary Commission under Sir Peter Lumsden. Sir William Lockhart knows well what his services were on that occasion; his patient, untiring devotion to duty as surveyor of the expedition in face of difficulties that would have paralyzed the courage and swamped the endurance of any ordinary man. Years afterwards, under very different circumstances, the opportunity occurred of testing the accuracy of the work so accomplished by more rigorous methods which the general advance of scientific surveys in these regions rendered feasible. I can only say that I have never ceased to marvel at the completeness and thoroughness of Woodthorpe's results, knowing well what he had to face in order to secure them.

On February 15, 1889, he was appointed by Lord Roberts chief of the Intelligence Branch of the Q.M.G.'s Department in India. No better selection could apparently have been made. The Indian Intelligence system is entirely different to that of England. In England, Intelligence officers can always work on the assured basis of sound maps. In India, both sound topography and general ethnological information have first to be secured by the Survey Department before

the Intelligence officer can graft his theories thereon; and thus the appointment of a survey officer of Colonel Woodthorpe's experience was entirely *apropos* to the requirements of the office. But the close daily routine of office life was not altogether congenial to his adventurous spirit, and he doubtless grew rather impatient of a system which kept him chained to a desk, and in which (as he said) he was the last officer to learn anything new. Independence of opinion is not always welcome in India, and Woodthorpe's views failed to accord with those of his military superiors. A reduction in the status of the office sent Woodthorpe back to his old love and his old life in the Survey. The change might have been altogether for his happiness, but that he accepted it as a reflection on his official capacity. There is no doubt that it affected him greatly, and to his many friends there certainly seemed to have been a want of appreciation of his brilliant services in the nature of those proceedings by which his retransfer was effected.

In the autumn of last year he was appointed Deputy Surveyor-General, which appointment he retained to the day of his death.

If there was one of his characteristics more than another which appealed to his friends, it was his unfailing spirit of genial good-fellowship. His was a cheeriness which spread in ripples around him, and influenced all who fell within its reach. No man could feel "sorry for himself" long in Woodthorpe's company. Such a spirit as this makes more for the final sum of the world's happiness, perhaps, than many of the arts and graces which adorn it. Not that Woodthorpe was insensible to the arts and graces either, for his love of painting amounted almost to devotion, and his accumulated store of life-illustrations is a legacy of which his family must be proud. But he was essentially a man of warm-hearted impulses, and nothing was too much for his generosity—no sacrifice too great for him to make in the interests of a friend.

The world is the poorer for his loss—as much the poorer as generous, true-hearted spirits like his are rare. What the loss to his relations must be it is not for me to say. Woodthorpe never married. He devoted himself with a single-hearted purpose to the interests of those dear to him, who, less happy than he, were not so well able to help themselves. May he rest in peace! He has left many behind who will ever keep his memory green, for we feel that, "taking him for all in all, we ne'er shall look upon his like again."

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1897-1898.

Afternoon Technical Meeting, Monday, June 27, *at* 4.30 *p.m.*—Sir CLEMENTS MARKHAM, K.C.B., President, in the Chair.

The Paper read was:—

"On a proposed Great Globe on a scale of 1:500,000." By Prof. Elisée Reclus.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

The following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce, Commercial.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
M. = Mitteilungen.
Mag. = Magazine.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue, Revista.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

EUROPE.

Sweden—Lake Mälar. *Ymer* (1897): 281–291. **Nerman.**

Några anteckningar om Mälaren och dess vattenstånd. Af Gustaf Nerman.

Sweden—Norrland. **Andersson.**

Den inre omflyttningen. I. Norrland-Akademisk Afhandling . . . af Theophil Andersson. Malmö, 1897. Size 9½ × 6½, pp. 60 and xxv. *Presented by the University of Upsala.*

On the movements of population in Norrland.

Sweden—Upsala. *Meteorolog. Z.* **14** (1897): 393–405. **Westman.**

Die Luftströmungen an der Erdoberfläche zu Upsala, 1891–1895. Von Dr. J. Westman.

On the winds at Upsala, discussed in all the bearings of meteorology.

Switzerland. *Globus* **73** (1898): 277–278. **Halbfass.**

Die Gemeinde Obersaxen, eine deutsche Sprachinsel im romanischen Vorderrheinthal. Von Dr. Halbfass.

Obersaxen is a German-speaking commune in the canton of Graubünden, in the midst of the Romanch-speaking districts.

Switzerland. ———

Les inondations et le reboisement de nos montagnes. La Société des forestiers suisses aux autorités fédérales, cantonales et communales. (Traduction.) Berne: Imp. Michel & Buckler, 1898. Size 9 × 6½, pp. 20. *Illustrations.*

Switzerland. *Rev. G.* **42** (1898): 284–287. **Corcelle.**

Le tunnel du Simplon. Par J. Corcelle.

The effect of the St. Gothard tunnel is said to have been a serious loss to France by the diversion of continental traffic from Marseilles to Genoa. The Simplon tunnel now in progress is anticipated to have a similar result.

Switzerland—Valais. *Rev. Scientifique* **9** (1898): 143–144. **Regnault.**

La langue française dans le Valais. Par M. Félix Regnault.

Turkey and Greece—Boundary. *Deutsche Rundschau G.* **20** (1898): 225–226. ———

Die neue Grenze zwischen der Türkei und Griechenland. *With Map.*

The map is remarkably clear, showing distinctly the areas ceded by Greece to Turkey.

United Kingdom. *J.R. Statistical S.* **61** (1898): 49–82. **Cannan.**

Demographic Statistics of the United Kingdom: their want of Correlation and other Defects. By Edward Cannan, M.A.

This paper deals critically with the movement of populations as expressed in the Registrar-General's returns, the composition of the population by nationality as dealt with in the immigration and emigration returns, and internal migration as dealt with in the census reports.

United Kingdom—England. **Phillimore and Whitear.**

Historical Collections relating to Chiswick. Edited by W. P. W. Phillimore and W. H. Whitear. London: Phillimore & Co., 1897. Size 8½ × 6, pp. 306. *Illustrations and Map.*

This book touches upon the meaning and origin of the place-names in the neighbourhood of Chiswick.

United Kingdom—England. **Reed.**

A Handbook to the Geology of Cambridgeshire, for the use of Students. By F. R. Cowper Reed, M.A. Cambridge: The University Press, 1897. Size 7½ × 5¼, pp. xii. and 276. *Sections. Price 7s. 6d. Presented by the Publishers.*

This is an admirable exposition of the geology of the country around Cambridge, prefaced by a short account of the physical geography of the locality, which will be referred to in the Monthly Record.

United Kingdom—England. **Williams, Eliot, Meade-King.**

P.I. Civil Engineers **131** (1898): 14–99.

The Manchester Ship-Canal. By Sir E. L. Williams. *Five Plates.* Ditto: Mersey Estuary Embankments.—Eastham Division. By W. Eliot. Ditto: Mersey Estuary Embankments and other Works.—Runcorn Division. By Sir E. L. Williams. Ditto: Irlam Division. By W. O. E. Meade-King. Discussion and Correspondence on ditto. *Three Cuts.*

United Kingdom—England. **Hay and Fitzmaurice.**

P.I. Civil Engineers **130** (1897): 50–98.

The Blackwall Tunnel. By David Hay and Maurice Fitzmaurice. *With Plans.*

A tunnel to connect Tilbury with Gravesend was commenced in 1798, and one between Limehouse and Rotherhithe in 1805, but both were abandoned. Brunel's brick tunnel under the Thames between Wapping and Rotherhithe was commenced in 1825 and finished in 1842. The only other tunnel beneath the Thames below London Bridge was the Tower sub-way, opened in 1869. The Blackwall tunnel Act was obtained in 1887, work was commenced in 1891, and the tunnel from Blackwall to Greenwich, of a total length of 6200 feet (1200 feet of which are under the river), was opened for foot passengers and vehicles in 1897. The tunnel in one place is only 5 feet below the bed of the river. It is lined throughout with white glazed bricks, and lighted by electricity.

United Kingdom—England. **Inglis.**

The "Contour" Road Book of England (Northern Division). A Series of Elevation Plans of the Roads, with Measurements and Descriptive Letterpress. By Harry R. G. Inglis. London: Gall & Inglis, 1897. Size 6½ × 4, pp. xxx. and 240. *Maps and Diagrams. Price 3s. 6d. Presented by the Publishers.*

A clear and serviceable guide to cyclists, showing the "ups and downs" of the principal roads in the north of England. The book is very compact and light, so as to be easily carried in the pocket.

United Kingdom—England. **Graham.**

The English Township. By T. H. B. Graham. From the *Gentleman's Magazine*, March, 1898, pp. 252–268. London: Chatto & Windus. Size 9 × 6.

A note on the district of Ditmarsh, between the Elbe and Eider, followed by a history of the origin of the English townships from the early Teutonic village lands.

United Kingdom—England. *Nineteenth Century* **43** (1898): 431–447. **Jessopp.**

Parish Life in England before the Great Pillage. By the Rev. Dr. A. Jessopp.

United Kingdom—England. *Quarterly J.R. Meteorolog. S.* **24** (1898): 42–50. **Marriott.**

The Rainfall of Seathwaite, Borrowdale, Cumberland. By William Marriott. *With Map and Illustrations.*

A note on this paper was given in the Monthly Record for June, vol. xi. p. 663.

United Kingdom—England. *Quarterly J.R. Meteorolog. S.* **24** (1898): 31–41. **Mossman.**

Daily Values of Non-Instrumental Meteorological Phenomena in London, 1763–1896. By R. C. Mossman. *With Diagrams.*

A note on this paper was given in the Monthly Record for June, vol. xi. p. 662.

United Kingdom—England. *Fortnightly Rev.* **63** (1898): 479–485. **Warren.**

The Westminster "Improvement" Scheme. By E. P. Warren. *With Plan.*

The plan shows the projected rebuilding of part of Westminster, the bill to authorize which has failed to pass the House of Commons.

United Kingdom—Ethnography. *British Assoc. Reports* (1897): 452–512. ——

Ethnographical Survey of the United Kingdom. Fifth Report of the Committee.

This report contains a further report on the Folklore of Galloway by the late Rev. Walter Gregor, reports of the ethnographical surveys in Wigtonshire, Kircudbrightshire, and East Anglia, and anthropometric notes relating to Aberdeen, Banffshire, the isle of Lewis, and Cleckheaton in Yorkshire, concluding with a report on the ethnographic survey of Ireland.

United Kingdom—Food-supply. *Nineteenth Century* **43** (1898): 879–889. **Marston.**

Our Urgent Need of a Reserve of Wheat. By R. B. Marston. *With Diagram.*

United Kingdom—Geology. *T. Edinburgh Geolog. S.* **7** (1897): 203–222. **Goodchild.**

Desert Conditions in Britain. An Address to the Geological Society of Edinburgh, at their Opening Meeting on November 19, 1896. By J. G. Goodchild. *With Plate.*

This was referred to in the Monthly Record for June, vol. xi. p. 662.

United Kingdom—Geological. *British Assoc. Reports* (1897): 298–332. **Watts.**

Photographs of Geological Interest in the United Kingdom.—Eighth Report of the Committee.

The work of this committee has been carried on energetically, 364 new photographs of geological interest having been added within the year 1896–97, and the whole collection, which is preserved in the Jermyn Street Museum, now includes 1751, dealing with the various divisions of the country as follows: England, 1027; Wales, 122; Channel Islands, 14; Isle of Man, 30; Scotland, 166; Ireland, 342; and typical rock structures, 50.

United Kingdom—Ireland. **Gardiner and Reynolds.**

Quarterly J. Geolog. S. **54** (1898): 135–148.

The Bala Beds and Associated Igneous Rocks of Lambay Island, co. Dublin. By C. I. Gardiner and S. H. Reynolds. *With Map and Sections.*

A geological map of Lambay island is given on the scale of 4 inches to the mile.

United Kingdom—Ireland. *T.R. Irish A.* **31** (1897): 23–38. **Coffey.**

Notes on the Prehistoric Cemetery of Loughcrew, with Fasciculus of Photographic Illustrations of the Sepulchral Cairns. By George Coffey.

United Kingdom—Ireland. *P.R. Dublin S.* **8** (1897): 421–431. **Kilroe.**

The Distribution of Drift in Ireland in its relation to Agriculture. By J. R. Kilroe. *With Map.*

United Kingdom—Ireland. *P.R. Dublin S.* **8** (1897): 475–507. **Praeger and Sollas.**

Report of the Committee . . . appointed by the Royal Dublin Society to investigate the recent Bog-flow in Kerry. Drawn up by R. Lloyd Praeger and Prof. Sollas. *With Plates.*

United Kingdom—Meteorology. ——

Report of the Meteorological Council, for the Year ending 31st of March, 1897, to the President and Council of the Royal Society. London: Eyre & Spottiswoode, 1897. Size 10 × 6½, pp. 124. *Map. Price* 8d. *Presented by the Meteorological Council.*

United Kingdom—Meteorology. ——

Official No. 129. Meteorological Observations at Stations of the Second Order for the Year 1894. With Frontispiece Map. Published by Direction of the Meteorological Council. London: Eyre & Spottiswoode, 1897. Size 12½ × 10, pp. 184. *Price* 27*s*. *Presented by the Meteorological Council.*

United Kingdom—Ordnance Survey Maps. ———

Board of Agriculture. Ordnance Survey Maps. I. Copies of Three Contracts entered into by the Board of Agriculture, with the Agents appointed for the Sale of Ordnance Survey Maps in London, Edinburgh, and Dublin. II. Copy of the Conditions upon which Agents are appointed in Provincial Towns. III. List of the Agents appointed in England and Wales, Scotland, and Ireland. IV. List of Post Offices at which Ordnance Survey Maps may be ordered. London: Eyre & Spottiswoode, 1897. Size 13 × 8¼, pp. 16. *Price 2d.*

United Kingdom—Scotland. *P.R.S. Edinburgh* **21** (1897): 105-115. **Mossman.**

On the Seasonal Death-rate from Certain Diseases in Edinburgh during the Period 1878-94, with Remarks on the Relation between Weather and Mortality. By R. C. Mossman. *With Plate.*

United Kingdom—Scotland. **White.**

The Flora of Perthshire. By Francis Buchanan W. White. Edited with an Introduction and Life of the Author, a list of his Scientific publications, and an Appendix. By James W. H. Trail. Edinburgh: Printed for the Perthshire Society of Natural Science by W. Blackwood & Sons, 1898. Size 7½ × 5¼, pp. lx. and 408. *Portrait and Map. Price 7s. 6d. Presented by the Publishers.*

The geographical part of the late Dr. Buchanan White's discussion of the flora of Perth includes the careful subdivision of that county into natural districts, in each of which the distribution of the indigenous plants could be considered. The book forms an important contribution to the slowly accumulating material for a complete geographical description of the British Islands.

United Kingdom—Scotland. **Mossman.**

T.R.S. Edinburgh **38** (1896): 681-756; **39** (1897): 63-208.

The Meteorology of Edinburgh. Parts i. and ii. By Robert C. Mossman. *With Plates. Presented by the Author.*

This monument of laborious compilation brings together a connected series of carefully discussed statistics of the meteorological conditions of Edinburgh for over one hundred years. Not only are instrumental observations discussed, but such observations as the number of days with rain or snow, the occurrence of thunderstorms, etc., are carefully recorded.

United Kingdom—Scotland. **Burns.**

The Coinage of Scotland. Illustrated from the cabinet of Thomas Coats, Esq., of Fergualie, and other Collections. By Edward Burns, F.S.A. SCOT. 3 vols. Edinburgh: A. & C. Black, 1887. Size 12½ × 10, pp. (vol. i.) xxiv. and 366; (vol. ii.) xviii. and 556; (vol. iii.) *Plates. Presented by the Family of the late Mr. Coats.*

These splendid volumes describe and figure the finest collection of Scottish coins ever brought together, with specimens from other collections, which make the monograph absolutely complete.

United Kingdom—Scotland. *P.I. Civil Engineers* **130** (1897): 276-297. **Kinipple.**

Greenock Harbour. By W. R. Kinipple. *With Plan.*

An account of new harbour works at Greenock, accompanied by a note on the growth of the port.

United Kingdom—Tide Tables. **Harris and Goalen.**

Tide Tables for the British and Irish Ports for the year 1898; also the times and heights of High Water at full and change for the principal places on the Globe. By Captains H. R. Harris and W. N. Goalen. London: J. D. Potter. Size 10 × 6¼, pp. xi. and 262. *Presented by the Hydrographer.*

United Kingdom—Wales. *Quarterly J. Geolog. S.* **54** (1898): 119-134. **Pollen.**

Exploration of Ty Newydd Caves, Tremeirchion, North Wales. By the Rev. G. C. H. Pollen, S.J. *With Plan and Sections.*

ASIA.

Russia—Caucasus. *Mém. Caucasian Sect. Imp. Russian G.S.* **19** (1897): 39-50. ———

Statistical information on Zakataly district, Gov. Elisabethpol, Trans-Caucasus. [In Russian.]

Russia—Caucasus. **Akinfiyeff.**

Mém. Caucasian Sect. Imp. Russian G.S. 19 (1897): 1–37.

Alpine Plants of Central Caucasus. By I. Akinfiyeff. [In Russian.]

A list of plants, the botanical names in Latin, and the range of height in feet.

Russia—Caucasus. **Dinnik.**

Mém. Caucasian Sect. Imp. Russian G.S. 19 (1897): Append. 1–81.

The Provence of Kuban at the sources of the rivers Vrushten and Belaya. By N. Ya. Dinnik. *With Map.* [In Russian.]

Russia—Caucasus. **Eristoff.**

Mém. Caucasian Sect. Imp. Russian G.S. 19 (1897): Append. 2, 1–111.

Notes on Svanetia. By Prince Raphail Davidovich Eristoff. [In Russian.]

Russia—Caucasus. **Kawraisky.**

Die Lachse der Kaukasusländer und ihrer angrenzenden Meere. Von F. F. Kawraisky. 2te Lieferung. Tiflis, 1897. Size 10 × 7, pp. 80. *Plates.*

On the Salmonidæ of the Caucasus. The memoir is in duplicate, Russian and German.

Russia—Caucasus. **Kondratenko.**

Mém. Caucasian Sect. Imp. Russian G.S. 19 (1897): 369–380.

Tables showing the distribution of the population of Trans-Caucasus according to religion. By E. Kondratenko. *With Map and Tables.* [In Russian.]

The map of the distribution of religious forms in the Trans-Caucasus is on the scale of 50 miles to an inch.

Russia—Caucasus. **Markovich.**

Mém. Caucasian Sect. Imp. Russian G.S. 19 (1897): 229–338.

In the forests of Ichkeria, Caucasus. By V. V. Markovich. [In Russian.] *With Illustrations.*

Describes the economic utilization of the forests, and the farming carried on in the district, with illustrations of the implements used.

Russia—Caucasus. *Nineteenth Century* 43 (1898): 717–723. **Napier of Magdala.**

The Caucasus and Tirah: a Retrospect. By the Right Hon. Lord Napier of Magdala.

A comparison of warfare in mountain regions held by independent tribes in different countries.

Russia—Caucasus. **Vinnikoff.**

Mém. Caucasian Sect. Imp. Russian G.S. 19 (1897): 169–194.

List of points in the Caucasus, geographically determined by the military-topographical section of the Caucasus. By N. Vinnikoff. [In Russian.]

The geographical co-ordinates of about 500 determined points are given, and also an alphabetical index of the places.

Russia—Sakhalin. **Dickins.**

A Journal kept in Karafuto. A Paper by Mr. F. Victor Dickins. Read before the Japan Society of London, December 11, 1895. Size 10 × 6½, pp. 30. *Illustrations. Presented by the Translator.*

Russia—Siberia. *Questions Diplomat. et Colon.* 1 (1897): 285–288. ———

L'état actuel du chemin de fer transsibérien, par un ingénieur russe. *With Map.*

Russia—Siberia. **Lopatin.**

I. A. Lopatin. Itinerary of the Turukhansk Expedition in 1866. Discussed by M. N. Miklukho-Maklay. Zapiski, Imperial Russian Geographical Society, General Geography, T. xxviii. No. 2. St. Petersburg, 1897. Size 10 × 7, pp. x. and 192. *Map and Diagrams.* [In Russian.]

On the geological results of the expedition, including a geological map of the Yenesei from Yeneseisk to the sea.

Russia—Siberia. *A travers le Monde, Tour du Monde* 4 (1898): 73–76. **Labbé.**

De Tomsk à Tachkent, l'Instruction publique—les Écoles russes et indigènes—l'Enseignement du français. Par M. Paul Labbé. *With Illustrations.*

On the system of education in South-Western Siberia and Central Asia.

Russia—Siberia. *Iz. Imp. Russian G.S.* **33** (1897): 34–47. **Bogdanevich.**
Letters from the Okhotsk-Kamchatka Expedition. By K. I. Bogdanevich. [In Russian.]

Russia—Siberia. *Tour du Monde* **3** (1897): 577, 589, 601, 613. **Chimkiévitch.**
Chez les Bouriates de l'Amour. Par M. Chimkiévitch. *With Map and Illustrations.*

Russia—Siberia. *Deutsche G. Blätter* **20** (1897): 129–178, 237–257. **Franz.**
Ueber die Möglichkeit einer ständigen Seeverbindung zwischen Europa und West-Sibirien. Von Dr. A. Franz.

An important practical paper dealing with the possibility of establishing permanent profitable sea-trade with Siberia. It takes account not only of the conditions of the route, but also of the resources and commercial prospects of Siberia. The paper is fortified by about 130 references to authoritative memoirs.

Russia—Siberia. *Yezhegodnik Imp. Russian G.S.* **7** (1897): 1–34. **Koversky.**
Sketch of the various Geodetic Works connected with the Construction of the Great Siberian Railway. By E. A. Koversky. [In Russian.]

Russia—Siberia. **Krahmer.**
Sibirien und die grosse Sibirische Eisenbahn. Von G. Krahmer. Leipzig: Zuckschwerdt & Co., 1897. Size 9½ × 6½, pp. vi. and 104. *Map. Price* 3*m.*

Russia—Siberia. *A travers le Monde, Tour du Monde* **4** (1898): 145–148. **Labbé.**
De Tomsk à Tachkent. Par M. Paul Labbé. *With Illustrations.*

Russia—Siberia. **Mostitz.**
Protocol Troitskosavsk-Kyakhta Br. Amur Sect. Imp. Russian G.S. No. 1 (1896): 5–17.
Traces of the Stone Age in the Valley of the River Selenga. By A. Mostitz. [In Russian.]

Russia—Siberia. *Iz. E. Siberian Sect. Imp. Russian G.S.* **28** (1897): 1–24. **Obrucheff.**
Excursion into the Gold-bearing Region of the Rivers Sarna and Ilikta in the western Baikal highlands. V. Obrucheff. *Map.* [In Russian, *résumé* in French.]

Russia—Siberia. **Patkanov.**
Die Irtysch-Ostjaken und ihre Volkspoesie. Von S. Patkanov. 1 Tiel. Ethnographisch-statistische Uebersicht. St. Petersburg, 1897. Size 12 × 8½, pp. viii. and 168. *Presented by the Imperial Academy of Sciences of St. Petersburg.*

A thorough study of the Ostyaks and their country.

Russia—Siberia. *Zemlevedenie* **4** (1897): 128–143. **Selnitzky.**
The Anadyr Region. By A. P. Selnitzky. *Tables.* [In Russian.]

Russia—Siberia. *Zemlevedenie* **3**, 1896 (1897): 51–110. **Soboleff.**
The Russian Altai Mountains. By M. Soboleff. *Illustrations.* [In Russian.]

Russia—Siberia. *Deutsche Rundschau G.* **20** (1897): 122–126. **Thiess.**
Handelsfahrten durch das Karische Meer, nach den sibirischen Flüssen Ob und Jenissei. Nach russischen Quellen von F. Thiess.

Russia—Siberia. *Iz. Imp. Russian G.S.* **33** (1897): 48–52. **Tronoff.**
The Sources of the River Bukhtorma. By V. Tronoff. *Map.* [In Russian.]

Russia—Siberia. *Iz. E. Siberian Sect. Imp. Russian G.S.* **28** (1897): 160–165. **Yokhelson.**
On the Vanished Races of Kolymsk District, Gov. Yakutsk. By V. Yokhelson. [In Russian, *résumé* in German.]

Linguistic studies attempting to solve the problem of a vanished tribe of North-Eastern Siberia known as Anauli, Khodintsi, Shelagi, Omoki, or Kangyenisi.

Russia—Siberia. *B.S.G. Marseille* **21** (1897): 362–373. **Saint-Yves.**
Omsk et le Gouvernement d'Akmolinsk. Par M. G. Saint-Yves.

Russia—Siberia. *Scottish G. Mag.* **14** (1898): 241–254. **Greig.**
A Journey from Kirin, Manchuria, overland to Moscow. By James A. Greig *With Illustrations.*

Russia—Siberia. *B. American G.S.* **30** (1898): 135–146. **Howard.**
Some Observations on Prisons in Vladivostock and Sakhalin. By Benjamin Howard.

Russia—Trans-Caspian Railway. *Globus* **73** (1898): 140–144. **Hahn.**

Die transkaspische Eisenbahn bis Tschardschui. Von C. v. Hahn. *With Illustrations.*

Description of a trip along the trans-Caspian line as far as Charjui, with interesting photographs of Geok-Tepe, Askabad, Merv, and Charjui.

Russia—Trans-Caucasia. **Lisovskii.**

Mem. Caucasian Sect. Imp. Russian G.S. **20** (1896): 1–232.

V. Ya. Lisovskii. trans-Caucasia. Part i. [In Russian.] *With Map.*

The first part of a comprehensive general account of trans-Caucasia, treating of the physical geography, with a remarkably clear map of the whole Caucasus region, on the scale of 1 : 100,000.

Russian Asia. *Iz. Imp. Russian G.S.* **33** (1897): 348–355. **Mushketoff.**

Exploration of Russian Glaciers in 1896. By I. V. Mushketoff. [In Russian.]

On the glaciers of the Caucasus, and the mountains of Central Asia and Southern Siberia.

Russian Central Asia. *Contemporary Rev.* **73** (1898): 680–697. **Adler.**

A Bird's-Eye View of the trans-Caspian. By E. N. Adler.

A record of a journey last year on the trans-Caspian railway to Samarcand.

Russian Central Asia. **Konshin.**

Solution of the problem on the ancient course of the Amu-Daria. According to contemporary geological and physico-geographical data. A. M. Konshin. Zapiski, Imperial Russian Geographical Society, General Geography. T. xxxiii. No. 1. St. Petersburg, 1897. Size 10 × 7, pp. 256. *Maps and Plates.* [In Russian.]

This is an elaborate discussion of the present condition of the region between the Murghab on the south, the Aral lake on the north, and the Caspian on the west, of which a geological map is given. The dunes of the desert region are considered incidentally, and some interesting drawings of them are reproduced.

Russian Central Asia. *Oesterreichische Monats. Orient.* **24** (1898): 25–29. **Rein.**

Eine Woche in Samarkand und am Serafschan. Von Prof. Dr. J. Rein.

Russian Turkestan. *Globus* **73** (1898): 268–272. **Vambéry.**

Bilder aus Russisch-Turkestan und Ferghana. Von H. Vambéry. *With Illustrations.*

Siam. **Smyth.**

Five Years in Siam, from 1891 to 1896. By H. Warington Smyth. 2 vols. London : John Murray, 1898. Size 8½ × 5½, pp. (vol. i.) [16] and 330; (vol. ii.) [10] and 338. *Maps and Illustrations. Price* 24*s*. *Presented by the Publisher.*

These volumes present in a handsome form the results of Mr. Warington Smyth's numerous adventurous journeys in Siam, which have, in part, already been described in the *Geographical Journal* and the extra publications of the Society. The descriptions of travel are supplemented by general chapters on Siamese history and politics, and by a collection of valuable appendices dealing with commercial statistics, natural phenomena, Siamese music and musical instruments. The book is beautifully illustrated by the author's sketches and from photographs.

Siam. **Young.**

The Kingdom of the Yellow Robe. Being Sketches of the Domestic and Religious Rites and Ceremonies of the Siamese. By Ernest Young. With Illustrations by E. A. Norbury. London : A. Constable & Co., 1898. Size 10 × 7, pp. xiv. and 400. *Price* 15*s*. *Presented by the Publishers.*

This deals with the people of Siam on the basis of several years' residence in Bangkok and much reading. The life and customs of the people are first considered, then the amusements, the predominant industry of rice-growing, which has a chapter to itself, the laws, and ceremonies for the dying and dead. A very full account is given of the temples and the religion of Siam, and the whole concludes with a chapter devoted to elephants. There are numerous illustrations from photographs and sketches.

Siam. *Imp. and Asiatic Quarterly Rev.* **5** (1898): 145–163. **Gerini.**

Shan and Siam. By Capt. G. E. Gerini.

A controversial discussion of the names *Shan* and *Siam*, and of some points in the history of Siam.

Turkey—Palestine. *Contemporary Rev.* **73** (1898): 706–713. **Prag.**

The Jewish Colonies in Palestine. By Joseph Prag.

The colonization of Palestine by Jewish agriculturists commenced in 1882; now the leading colony at Jaffa has about 500 inhabitants engaged in vine-culture, and there are twenty others, the largest of which is at Zichron Jakob with 2000 settlers, most of them from Eastern Europe.

Turkey—Palestine. **Hornstein.**

Palestine Exploration Fund, Quarterly Statement (1898): 94–103.

A Visit to Kerak and Petra. By Charles Alexander Hornstein. *With Map and Illustrations.*

A journey in 1895, with some admirable photographs of towns and scenery.

Turkey—Palestine. *Palestine Exploration Fund, Q. Statement* (1898): 7–20. **Schick.**

Ramathaim-Zophim—the Home of Samuel the Prophet. By Dr. C. Schick. *With Map.*

Turkey—Syria. *B.S.G. Lyon* **14** (1898): 766–794. **Chevrillon.**

La Syrie (Impressions de Voyages). Par M. Chevrillon.

Turkey—Syria. **Cuinet.**

Syrie, Liban et Palestine. Géographie administrative, statistique, descriptive et raisonnée. Par Vital Cuinet. Fascicule 3. Paris: E. Leroux, 1898. Size 11 × 7½, pp. 301–460. *Map.*

Turkey—Syria. **Birch.**

Palestine Exploration Fund, Quarterly Statement (1898): 110–121.

The Prospect from Pisgah. By Rev. W. F. Birch.

A discussion of the limits of the view from Pisgah.

Turkey—Syria. *A travers le Monde, Tour du Monde* **4** (1898): 41–44. **Parisot.**

Le chemin de fer de Beyrout à Damas et Mzérib. Par J. Parisot. *With Illustrations.*

Turkey—Syria and Palestine. *Zemlevedenie* **3**, 1896 (1897): 19–50. **Birkenheim.**

The Present Economic State of Syria and Palestine. By A. M. Birkenheim. [In Russian.]

Western Asia. *J. of T. Victoria I.* **30** (1898): 29–85. **Rassam.**

Biblical Lands, their Topography, Races, Religions, Languages and Customs, Ancient and Modern. By Hormuzd Rassam. *With Map.*

The article deals almost exclusively with the Jews, Armenians, Kurds, and Chaldæans.

AFRICA.

Abyssinia. *Questions Dipl. et Colon.* **4** (1898): 12–19. **De la Genardière.**

Les Provinces équatoriales d'Éthiopie. Par G. de la Genardière.

Abyssinia. *C. Rd., S.G. Paris* (1898): 137–141. **Darragon and Poncins.**

Éthiopie. Le Sidama, l'Amara, le Konso, etc. Par M. Léon Darragon. *With Map.*

Issas et Adals: Abako. Par Vicomte Edm. de Poncins.

African Travel. *B.S.G. Paris* **19** (1898): 107–133, 109–142. **Foa.**

Séance extraordinaire. Réception de M. Édouard Foa, explorateur dans l'Afrique équatoriale. *With Map.*

Traversée de l'Afrique équatoriale. Du Zambèze au Congo par les grands lacs (Août 1894—Novembre 1897). Par Édouard Foa. Observations astronomiques et magnétiques et altitudes en mètres des principaux points de l'itinéraire, suivies d'un résumé des autres travaux de l'expédition.

Congo State—Kasai. *Mouvement G.* **15** (1898): 215–216. **Wauters.**

Le Kasai et ses affluents. Par A. J. Wauters. *With Map.*

The description of the Kasai accompanies the ninth sheet of the map of the Congo State on the scale of 1: 2,000,000.

East African Islands. *B.S.R.G. d'Anvers* **22** (1898): 37–53. **Mager.**

Souvenirs de Voyages aux Iles de la Côte Orientale d'Afrique. Madagascar, Réunion, Sainte-Marie, Nossi-Bé, Mayotte. Par M. Henri Mager.

Notes and observations of a popular kind.

French Congo—Brazzaville. **Bourdarie.**

L'avenir de Brazzaville. Par M. P. Bourdarie. No. 4.—Renseignements Coloniaux et Documents publiés par le Comité de l'Afrique Française. Size 12 × 9, pp. 101–106. *Map.*

On the probable effect of the completion of the Congo railway on Brazzaville.

French Possessions. *Deutsche Rundschau G.* **20** (1898): 364–368. **Rumpe.**

Frankreichs Afrikabesitz und seine geschichtliche Entwickelung. Von Dr. med. Robert Rumpe. *With Map.*

The map on the scale of 1: 30,000,000 is coloured, so as to contrast the area of the French possessions in 1878 and 1898.

French Sudan. **Lartigue.**

Notice historique sur la région du Sahel. Par le commandant de Lartigue. No. 4.—Renseignements Coloniaux et Documents publiés par le Comité de l'Afrique Française. Size 12 × 9, pp. 69–101.

A history of the French advance from the Senegal to the Niger.

French West Africa—Ivory Coast. *Ann. G.* **7** (1898): 273–277. **Eysséric.**

Exploration du Bandama (Côte d'Ivoire) (1896–1897). Par M. J. Eysséric. *With Map and Plates.*

German East Africa. *Petermanns M.* **44** (1898): 73–81. **Werther.**

Die mittlern Hochländer des nördlichen Deutsch-Ostafrika. Von Prem.-Leutn. W. Werther. *With Map.*

This will be specially noticed.

Sahara. *B.S.G. Paris* **17** (1896): 518–534. **Cornetz.**

Le Sahara tunisien, étude géographique. Par V. Cornetz. *With Map.*

Sahara. *Ann. G.* **7** (1898): 180–183. **Schirmer.**

Le Sahara inconnu. L'Adrar des Aouélimmiden. Par M. H. Schirmer.

Sahara—In-Sâlah. *C. Rd., S.G. Paris* (1898): 85–89. **Foureau.**

Longitude d'In-Sâlah. Par F. Foureau.

The longitude of In-Salah was given in the *Quarterly Review*, in an account of Laing's journey, as 2° 15′ E.; on the authority of Sir E. Sabine, Laing's longitude was 1° 51′ E.; Hassenstein, in his map of Rohlf's travels, makes it 2° 10′ E.; while M. Foureau's own result is 2° 43′ E. of Greenwich.

Sahara—Tuareg. *Questions Diplomat. et Colon.* **2** (1897): 33–39. **Attanoux.**

Ce qu'il faut penser des Touareg. Par M. J. Bernard d'Attanoux. *With Map.*

The article contains a list of travellers who were well received in the Sahara and north-western Sudan, and a map of the places at which travellers had been massacred, with the object of showing that the people of the Tuareg confederation are not so dangerous as usually supposed.

Somaliland. **Millosevich.**

Elia Millosevich. Discussione delle osservazioni astronomiche fatte dal tenente di vascello Lamberto Vannutelli addetto alla seconda Spedizione Bòttego in Africa. Estratto dalle Memorie della Società Geografica Italiana vol. viii. 1898. Roma, 1898. Size 9½ × 6¼, pp. 60. *Presented by Lieut. L. Vannutelli.*

The astronomical, magnetic, and other observations are recorded and discussed.

Somaliland. *Petermanns M.* **44** (1898): 49–55. **Paulitschke.**

Reise des Grafen Eduard Wickenburg im Somâl-Lande, Juni bis Oktober 1897. Von Prof. Dr. Philipp Paulitschke. *With Map.*

This will be separately referred to.

Somaliland. *Questions Diplomat. et Colon.* **1** (1897): 413–419. **Noll.**

Les explorations italiennes dans la péninsule des Somalis. Par M. Ned Noll. *With Map.*

South Africa. **Stanley.**

Through South Africa. By Henry M. Stanley, M.P., D.C.L. Being an Account of his recent visit to Rhodesia, the Transvaal, Cape Colony, and Natal. Reprinted,

with Additions, from 'South Africa.' London: Low & Co., 1898. Size 7½ × 5, pp. xx. and 140. *Map and Illustrations. Price* 2*s.* 6*d. Presented by the Publishers.*

The narrative of a tour in South Africa on the occasion of the opening of the Bulawayo railway, with personal impressions and political remarks.

South Africa. **Younghusband.**

South Africa of To-day. By Captain Francis Younghusband. London: Macmillan & Co., 1898. Size 9½ × 6, pp. 178. *Illustrations. Price* 8*s.* 6*d.*

South Africa—Rhodesia.

The British South Africa Company. Reports on the Native Disturbances in Rhodesia, 1896-97. Printed for the information of Shareholders by order of the Board of Directors. March, 1898. Size 10½ × 8½, pp. 160. *Map and Plans.*

South-West Africa. *Ymer* (1898): 49–89. **Möller.**

Iakttagelser under en resa i sydvästra Afrika. Af Peter Möller. *With Map and Illustrations.*

A journey from Mossamedes to Humbe, on the Cunene, whence part of the upper streams of that river were explored; then south through Ovampoland, in about longitude 16° E.; and, finally, south-westward to Walfisch bay.

Sudan—Bahr el Ghazal. *Mouvement G.* **15** (1898): 13–18. **Wauters.**

Les missions Liotard et Marchand. Par A. J. Wauters. *With Sketch-map, Portrait, and Illustration.*

These expeditions are referred to in the *Journal* for February, vol. xi. p. 169.

Transvaal. *Quarterly J. Geolog. S.* **54** (1898): 73–100. **Hatch.**

A Geological Survey of the Witwatersrand and other Districts in the Southern Transvaal. By Frederick H. Hatch, PH.D. *With Map and Sections.*

Also a separate copy, *presented by the Author.*

West Africa. *B.S.G. Com. Paris* **20** (1898): 42–53. **Bretonnet.**

Le Moyen-Niger français. Par M. le lieutenant Bretonnet. *With Map.*

West Africa. *Contemporary Rev.* **73** (1898): 698–705. **Robinson.**

The Slave Trade in the West African Hinterland. By Canon C. H. Robinson.

Mr. Robinson lays stress on the want of a coinage for interior Africa, pointing out that the slave-trade is encouraged by the use of slaves as a convenient currency which may be changed anywhere.

West Africa. *Ann. G.* **7** (1898): 230–238. **Schirmer.**

Principaux résultats géographiques des explorations récentes dans la boucle du Niger. Par M. H. Schirmer.

West Africa. *Imp. and Asiatic Quarterly Rev.* **5** (1898): 321–343. **Bourne.**

France and England in West Africa. By H. R. Fox Bourne.

A history of the development of West Africa by British and French enterprise.

West Africa. *Rev. Française* **23** (1898): 193–212. **Demanche.**

Hinterland du Dahomey: La mission Baud-Vermeersch au Gourma.—La mission Bretonnet au Niger. Par G. Demanche. *With Map.*

West Africa. *Contemporary Rev.* **73** (1898). **Westlake.**

England and France in West Africa. By Prof. J. Westlake.

West Africa. *B. Comité l'Afrique Française* **7** (1897): 425–428. **Bourdarie.**

Du Congo à la Méditerranée: La mission F. de Béhagle. Par M. P. Bourdarie. *With Map.*

West Africa. *B.S.G. Commerc. Paris* **19** (1897): 752–760. **Chanoine.**

Mission au Gourounsi. Par le lieutenant Chanoine.

West Africa. *Globus* **72** (1897): 336–338. **Förster.**

Die englisch-französischen Streitfragen in Westafrika. Von Brix Förster. *With Map.*

West Africa. *Petermanns M.* **43** (1897): 225–236, 262–267. **Frobenius.**

Der Westafrikanische Kulturkreis. Von L. Frobenius. *With Maps.*

A discussion of the distribution in Africa of the different types of shields, of bows, of certain forms of house, and of types of clothing material, illustrated by ten maps.

West Africa. *Fortnightly Rev.* **62** (1897): 917–925. **Greswell.**
England and France in West Africa. By Rev. W. Greswell. *With Map.*
Historical references and a map of the present condition of affairs.

West Africa. *B. Comité l'Afrique Française* **7** (1897): 415–422. **Mille.**
Le voyage de M. André Lebon dans l'Afrique occidentale. Par M. Pierre Mille.

West Africa. *B.S.G. Com. Paris* **19** (1897): 729–751. **Voulet.**
Au Mossi et au Gourounsi. Par le capitaine Voulet, 1896–1897. *With Map.*

West Africa. *C. Rd. S.G. Paris* (1897): 301–307. **Voulet and Chanoine.**
Mission Voulet-Chanoine au Mossi et au Gourounsi (1896–1897). Jonction du Soudan au Dahomey. Objet et marche de la mission, résultats obtenus; le pays et ses habitants.

NORTH AMERICA.

Bermuda. **Cole.**
Bulletin of Bibliography Pamphlets. No. 2. Bermuda in Periodical Literature. A Bibliography. By George Watson Cole. Boston: the Boston Book Co, 1898. Size 6 × 4½, pp. 26. *Presented by the Author.*
An interesting collection of the titles of magazine articles on Bermuda, with occasional editorial notes. The entries range in date from 1664 (*Phil. Trans.*) to 1897.

Canada. ———
Annual Report of the Department of the Interior for the Year 1897. Ottawa, 1898. Size 10 × 6½, pp. [596]. *Plates and Maps.*
This report deals with the Dominion lands, the Dominion land-surveys, irrigation, immigration, together with special reports on the North-West Territories, Keewatin, the Rocky Mountains Park, and the Swan River valley.

Canada—Alberta. *Appalachia* **8** (1898): 320–327. **Thompson.**
At the Headwaters of the Bow. By Charles S. Thompson. *With Illustrations.*

Canada—British Columbia. ———
Annual Report of the Minister of Mines for the Year ending December 31, 1897, being an account of Mining Operations for Gold, Coal, etc., in the Province of British Columbia. Victoria, B.C., 1898. Size 10½ × 7½, pp. 449–640. *Map and Plates.*
Photographs are given of a number of the mines, the working of which is fully described.

Canada—British Columbia. *Appalachia* **8** (1898): 327–336. **Habel.**
The North Fork of the Wapta. By Jean Habel. *With Illustrations.*

Canada—Ethnological Survey. *British Assoc. Reports* (1897): 440–451. ———
An Ethnological Survey of Canada. First Report of the Committee.
This report describes the methods by which an ethnological survey of Canada is proposed to be carried out, and includes two appendices: one on the growth of Toronto children, by Franz Boas; the other on the origin of the French Canadians, by B. Sulte, discussing the parts of France from which the ancestors of the present French-speaking population came.

Canada—Historical. *P. & T.R.S. Canada* **2** (1896) (sect. i.): 35–58. **Gosselin.**
Quelques observations à propos du voyage du P. le Jeune au Canada en 1660, et du prétendu voyage de M. de Queylus en 1664. Par M. l'Abbé Gosselin.

Canada—Hudson Bay. **Wakeham.**
Report of the Expedition to Hudson Bay and Cumberland Gulf in the Steamship *Diana*, under the command of William Wakeham, Marine and Fisheries, Canada, in the year 1897. Ottawa, 1898. Size 10 × 6½, pp. 84. *Maps and Illustrations. Presented by the Colonial Office.*
This expedition will be referred to elsewhere in the *Journal*.

Canada—Hudson Bay. *Globus* **73** (1898): 105–106. **Bach.**
Die Canadische Expedition zur Hudsonbai und nach Baffinland. Sommer 1897. Von R. Bach.
An account of the Canadian expedition, which will be fully described in the *Journal*.

Canada—New Brunswick. **Ganong.**

A Monograph of the Cartography of the Province of New Brunswick. By W. F. Ganong, M.A., PH.D. (From the *Transactions* of the Royal Society of Canada. Second Series—1897-98. Vol. ii. sect. ii.) Ottawa: J. Durie & Son, 1897. Size 10 × 7, pp. 313-428. *Maps. Presented by the Author.*

After a general discussion of the character of old maps and the method of studying them, the maps of New Brunswick are considered as belonging to eight different types arranged chronologically; from the "Pre-differentiation type" of 1500 to 1534, to the "Exact type," which, for New Brunswick, does not yet exist. There are lists of maps and a bibliography as appendices.

Canada—North-West Territory. *National G. Mag.* 9 (1898): 105-112. **Scidmore.**

The North-West Passes to the Yukon. By Eliza Ruhamah Scidmore. *With Illustrations.*

Historical notes on the various crossings of the passes of the Coast range into the Yukon district and Alaska.

Canada—Nova Scotia. *P. & T.R.S. Canada* 2 (1896) (sect. iv.): 167-179. **Gilpin.**

Coal-Mining in Pictou County. By E. Gilpin, junr., LL.D. *With Map.*

A history of coal-mining in Nova Scotia.

Canada—St. Lawrence. **Dawson.**

Character and Progress of the Tides in Gulf and River St. Lawrence as ascertained by simultaneous observations with self-registering Tide-Gauges. By W. Bell Dawson. (From the *Transactions* of the Royal Society of Canada. Second Series—1897-98. Vol. iii. sect. iii. Mathematical, Physical, and Chemical Sciences.) Ottawa: J. Durie & Son, 1897. Size 10 × 7, pp. 51-68. *Chart and Diagrams.*

Canada—Tides and Currents. **Dawson.**

Survey of Tides and Currents in Canadian Waters. Report of Progress by W. Bell Dawson. Ottawa, 1898. Size 10 × 7, pp. 16. *Map and Diagrams.*

Canada—Yukon District. *National G. Mag.* 9 (1898): 113-116. **Garland.**

Overland Routes to the Klondike. By Hamlin Garland. *With Illustration.*

The routes considered are from Edmonton, and the old telegraph trail up the Fraser river from Ashcroft, or Kamloops, concerning all of which information is scanty.

Canada—Yukon Goldfields. *National G. Mag.* 9 (1898): 117-120. **Dall.**

The Future of the Yukon Goldfields. By Prof. William H. Dall.

The future considered is the very immediate one of next winter, the paper dealing with the disparity between the number of miners reaching Klondike and the possible transportation for their necessary supplies.

Historical—Cabot. *P. & T.R.S. Canada* 2 (1896) (sect. ii.): 3-30. **Dawson.**

The Voyages of the Cabots in 1497 and 1498. A sequel to a paper in the *Transactions* of 1894. By Samuel Edward Dawson. *With Maps and Illustration.*

Mexico—Lower California. **Merrill.**

Smithsonian Institution. United States National Museum. Notes on the Geology and Natural History of the Peninsula of Lower California. By George P. Merrill. From the Report of the U.S. National Museum for 1895, pp. 969-994. *With Ten Plates.* Washington, 1897. Size 10 × 6¼.

Mexico—Orizaba. *Appalachia* 8 (1898): 350-355. **Cogshall.**

A Trip to the Summit of Orizaba. By W. A. Cogshall. *With Illustration.*

Mexico—Orizaba and Popocatepetl. *Appalachia* 8 (1898): 356-361. **Douglass.**

The Altitudes of Orizaba and Popocatepetl. By A. E. Douglass.

United States—California. *American J. Sci.* 5 (1898): 355-375. **Ransome.**

Some Lava Flows of the Western Slope of the Sierra Nevada, California. By F. Leslie Ransome. *With Maps.*

United States—Cliff Dwellings. *B. American G.S.* 30 (1898): 111-123. **Mindeleff.**

Origin of the Cliff Dwellings. By Cosmos Mindeleff.

United States—Massachusetts. **Marindin.**

Tables of Cross Sections on the North Shores of Nantucket and Martha's Vineyard, Massachusetts. By H. L. Marindin. Report of the Superintendent of the U.S. Coast and Geodetic Survey, showing the progress of the work during the Fiscal Year ending with June, 1896. Pp. 305–346. Washington, 1897. Size 12 × 9½.

These measurements were made with the object of determining the position of the shore-line as a measure of past erosion, and as a standard from which future erosion may be calculated.

United States—Michigan. *Science* **7** (1898): 577–585. **Spalding.**

A Natural History Survey of Michigan. By Prof. V. M. Spalding.

Historical account of the natural history survey of Michigan.

United States—Ozark Region. *Science* **7** (1898): 588–589. **Keyes.**

The Myth of the Ozark Isle. By Dr. Charles R. Keyes.

The outcrop of the dome-like Ozark Uplift of ancient rocks in the midst of the more recent sediments of the Mississippi Basin, has been held to prove the existence of an island in the Palæozoic ocean which had never since been submerged; but the author points out evidence of the phenomenon being due to a comparatively recent uplift followed by extensive denudation.

United States—Pennsylvania. **Bascom.**

Department of the Interior. Bulletin of the United States Geological Survey. No. 136. The Ancient Volcanic Rocks of South Mountain, Pennsylvania. By Florence Bascom. Washington, 1896. Size 9½ × 6, pp. 124. *Maps and Plates. Presented by the Survey.*

United States—Sierra Nevada. **Turner.**

Further Contributions to the Geology of the Sierra Nevada. By H. W. Turner. Part i. Pp. 529–740. *Maps and Illustrations.* Washington, 1896. Size 12 × 8. —Seventeenth Annual Report of the United States Geological Survey . . . 1895-96.

United States—Wisconsin. *J. Geology* **6** (1898): 182–192. **Squier.**

Studies in the Driftless Region of Wisconsin. II. By G. H. Squier. *With Sketch-Maps.*

On the character and origin of land-forms.

Washington and British Columbia. **Hodges.**

Mining in the Pacific North-West. A Complete Review of the Mineral Resources of Washington and British Columbia. Edited by L. K. Hodges. Seattle, 1897. Size 9 × 6, pp. 192. *Maps. Presented by the Editor.*

CENTRAL AND SOUTH AMERICA.

British Guiana Boundary. *Rev. G.* **42** (1898): 356–360. **Pariset.**

Le Contesté anglo-vénézuélien en Guyane. Par G. Pariset.

British West Indies. *J.R. Colonial I.* **29** (1898): 313–344. **Carrington.**

Our West Indian Colonies. By George Carrington, B.A.

This paper deals mainly with the economic conditions of the West Indies.

Chile. *Tour du Monde* **2** (1896): 577, 589, 601, 613; **4** (1898): 181, 193, 205. **Cordemoy.**

Au Chili. Par M. C. de Cordemoy. *With Illustrations.*

Chile and Argentine Boundary. *Ann. G.* **7** (1898): 239–262. **Delachaux.**

La question des limites chilo-argentines. Examen d'un article du Dr. Steffen. Par M. Henri F. Delachaux. *With Map.*

Also separate copy. *Presented by the Author.*

Colombia. *Verh. Ges. Erdk. Berlin* **25** (1898): 167–176. **Regel.**

Herr Prof. Dr. Fritz Regel: Über seine Reisen im nordwestlichen Kolumbien 1896–97. *With Map.*

Costa Rica. *Ann. Hydrographie* **26** (1898): 102–104. ———

Naranjo (Costa Rica). Juli 1897.

On the harbour of Naranjo.

Cuba. *Fortnightly Rev.* **63** (1898): 855-866. **Lee.**
Cuba and her Struggle for Freedom. By Major-General Fitzhugh Lee.

Ecuador and Peru—Amazons. *Z. Ges. Erdk. Berlin* **32** (1897): 360-409. **Rimbach.**
Reise im Gebiet des oberen Amazonas. Von Dr. A. Rimbach. *With Map.*

Haiti. *Deutsche Rundschau G.* **20** (1898): 289-298, 355-364. **Fischer-Treuenfeld.**
Reminiscenzen eines haïtianischen Regierungsbeamten. Von R. v. Fischer-Treuenfeld. *With Illustration.*
Deals largely with the economic conditions of the Haitian Republic.

Paraguay. *B.S.G. Madrid* **39** (1897), (Suppl.): 1-86. **Garay.**
El Comunismo de las Misiones de la Compañía de Jesús en el Paraguay. Conferencia pronunciada por D. Blas Garay.

Patagonia. *C. Rd., S.G. Paris* (1898): 98-102. **De la Vaulx.**
A travers la Patagonie, du Rio Negro au Détroit de Magellan. Par le comte Henry de la Vaulx. *With Map.*

South America. *Ymer* (1898): 31-48. **Hultkrantz.**
Nagra bidrag till Sydamerikas fysiska antropologi. Af J. Hultkrantz. *With Illustrations.*
A study of the anthropological collections brought back from Nordenskiöld and Dusen's expedition in the extreme south of South America.

West Indies. **Morris.**
Royal Gardens, Kew. Bulletin of Miscellaneous Information. Additional Series I. Report on the Economic Resources of the West Indies, by D. Morris, C.M.G., etc. London: Eyre & Spottiswoode, 1898. Size 9½ × 6, pp. viii. and 166. *Map. Price* 1*s.* 6*d. Presented by the Director, Royal Gardens, Kew.*

West Indies—Cuba. *Fortnightly Rev.* **63** (1898): 705-722. **Davey.**
Glimpses of Havana and the Havanese. By Richard Davey.

AUSTRALASIA AND PACIFIC ISLANDS.

Queensland—Ethnology. **Roth.**
Ethnological Studies among the North-West-Central Queensland Aborigines. By Walter E. Roth. Brisbane, 1897. Size 10 × 6½, pp. xvi. and 200. *Map and Plates. Presented by the Agent-General for Queensland.*
A very remarkable original study of the Queensland aborigines.

Rotuma. *Quarterly J. Geolog. S.* **54** (1898): 1-11. **Gardiner.**
The Geology of Rotuma. By J. Stanley Gardiner. With an Appendix by H. Woods. *With Map and Plan.*
This is the subject of a note, p. 193.

Society Islands. *A travers le Monde, Tour du Monde* **4** (1898): 97-100. ——
L'Expédition de Raïatéa en 1897. *With Illustrations.*
The expedition the visit of which to the Society islands is here described was sent out in order to bring the islands effectively under the control of France.

South Australia—Horn Expedition. *Petermanns M.* **44** (1898): 1-9. **Hahn.**
Die Horn-Expedition in Zentralaustralien und ihre geographischen Ergebnisse. Von Prof. Dr. F. Hahn. *With Map.*

Tasmania and New Zealand. *Deutsche G. Blätter* **21** (1898): 22-30. **Greffrath.**
Geographisch-statistische Uebersicht über die australischen Kolonien. IV. Die Inselkolonie Tasmanien. V. Die Kolonie Neu-Seeland. Von Henry Greffrath.

Western Australia. **Maitland.**
Reports by the Government Geologist in connection with the Water Supply of the Goldfields. Perth. Size 13 × 8½, pp. 8. *Maps. Presented by the Government Geologist.*

Western Australia. ——
The Abrolhos Tragedy. Australia's First White Residents. The Batavia's Castaways. How they Fought and Suffered. [First Complete Translation in

English of the Original Dutch Account, Published Eighteen years after the Massacre.] From the *Western Mail*, Christmas Number, 1897, pp. 3–11. Perth, W.A. Size 19 × 13½. *Map and Illustrations.*

Western Australia. *T. Edinburgh Geolog. S.* 7 (1897): 174–182. **Cadell.**

Some Geological Features of the Coast of Western Australia. By Henry M. Cadell, B.SC.

The result of a visit to the Pilbarra goldfield, in the north-west of Western Australia, in 1895.

Western Australia. *Scottish G. Mag.* 14 (1898): 113–136. **Carnegie.**

Explorations in the Interior of Western Australia, between Coolgardie and Kimberley. By the Hon. David W. Carnegie. *With Map and Illustrations.*

This paper was also published in the *Journal* for March, p. 258. The map is, however, different; although on a smaller scale, it includes the whole of Western Australia, and the routes of other recent travellers.

POLAR REGIONS.

Greenland. *G. Tidskrift* 14 (1898): 116–123. **Ryberg.**

Fra Missions- og Handelstationen ved Angmagssalik. Af Carl Ryberg.

An account of the new Danish enterprise in establishing mission and trading station on the east coast of Greenland.

Greenland—Ice Conditions. *Petermanns M.* 44 (1898): 55–64. **Drygalski.**

Die Eisbewegung, ihre physikalischen Ursachen und ihre geographischen Wirkungen. Von Dr. Erich v. Drygalski. *With Illustrations.*

The article is founded on Dr. von Drygalski's great report on his Greenland expedition.

Spitsbergen. *Quarterly J. Geol. S.* 54 (1898): 197–227. **Garwood and Gregory.**

Contributions to the Glacial Geology of Spitsbergen. By E. J. Garwood, M.A., and J. W. Gregory, D.SC. *With Map and Plates.*

This comprehensive paper treats of the glaciers of Spitsbergen and their action, the varieties of moraine produced by them, the action of marine ice in transporting material and in erosion, traces of former glaciations, and concludes with a series of general conclusions.

Spitsbergen. **Conway.**

With Ski and Sledge over Arctic Glaciers. By Sir Martin Conway. Illustrated from Photographs taken by E. J. Garwood. London: J. M. Dent & Co., 1898. Size 8 × 5½, pp. vi. and 240. *Map. Price* 6*s. Presented by the Publishers.*

Sir Martin Conway calls this book an appendix to that describing his first journey in Spitsbergen. He cordially recognizes the services of his companions by name in the preface, but kindly veils the identity of a hired Norwegian who was a hindrance. The geographical results of the expedition will be published in full in the *Journal*. The record of the journey is diversified by the historical associations of the now desolate country, which was formerly a summer rendezvous of thousands of whalers and hunters.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Meteorology—Kites. *Globus* 73 (1898): 272–276. **Herrmann.**

Die Verwendung von Drachen zu wissenschaftlichen Zwecken. Von Dr. E. Herrmann. *With Illustrations.*

On the use of kites for scientific observations.

Oceanography. **Pettersson and Ekman.**

K. Svensk. Vet.-A. Handlingar 29 (1897): No. 5.

De hydrografiska förändringarne inom Nordsjöns och Östersjöns område under tiden 1893–1897. Af Otto Pettersson och Gustaf Ekman. *With Charts and Sections.* Pp. 1–126.

A discussion of the oceanographical conditions of the western Baltic and Gulf of Bothnia.

Oceanography. *Verh. Ges. Erdk. Berlin* **25** (1898): 111–127. **Schott.**

Dr. Gerhard Schott: Die oceanographischen Aufgaben und der voraussichtliche Verlauf der geplanten deutschen Tiefsee-Expedition 1898–99.

This is referred to in a note, vol. xi. p. 673.

Oceanography. *B.S.G. Com. Bordeaux* **21** (1898): 81–100. **Thoulet.**

Étude sur la distribution de la magnétite dans les fonds du golfe de Gascogne. Par J. Thoulet. *With Chart.*

Oceanography—Deposits. *P.R.S. Edinburgh* **21** (1897): 25–34. **Hartley.**

On the Cause and Nature of the Chemical Changes occurring in Oceanic Deposits. By Wm. Hartley.

Oceanography—Deposits. *P.R.S. Edinburgh* **21** (1897): 35–39. **Irvine and Murray.**

On Chemical Changes in Marine Muds. By Robert Irvine and John Murray, LL.D.

Oceanography—Fauna. **Monaco.**

Résultats des Campagnes Scientifiques accomplies sur son yacht par le Prince Albert 1er, Prince de Monaco, publiés sous sa direction avec le concours du Baron Jules de Guerne, et M. Jules Richard. Fasc. I.—XII. Imprimerie de Monaco, 1889–1898. Size 14 × 11½. *Maps and Plates. Presented by H.S.H. the Prince of Monaco.*

These fine volumes contain the reports of specialists on the collections made by the Prince of Monaco on his yacht.

Oceanography—North Atlantic. **Pettersson and Ekman.**

Die hydrographischen Verhältnisse der Oberen Wasserschichten des nördlichen Nordmeeres zwischen Spitzbergen, Grönland und der Norwegischen Küste in den Jahren 1896 und 1897. Von O. Pettersson und G. Ekman. Unter Mitwirkung von P. T. Cleve.—Bihang till K. Svenska Vet.-Akad. Handlingar. Band 23, Afd. II., No. 4. Stockholm: P. A. Norstedt & Söner, 1898. Size 8½ × 6, pp. 56. *Maps and Plate. Presented by the Authors.*

The results of this research are given by Prof. Pettersson in the *Journal* for June, vol. xi. p. 611.

Physical Geography. **Klein.**

Jahrbuch der Astronomie und Geophysik. Enthaltend die wichtigsten Fortschritte auf den Gebieten der Astrophysik, Meteorologie und physikalischen Erdkunde. Unter Mitwirkung von Fachmännern herausgegeben von Dr. Hermann J. Klein. VIII. Jahrgang, 1897. Leipzig: E. H. Mayer, 1898. Size 9 × 6, pp. viii. and 370. *Maps and Plates.*

River-temperature. *P. & T.R.S. Canada* **2** (1896) (Sec. iii.): 37–44. **Barnes.**

On some Measurements of the Temperature of the River Water opposite Montreal, made during the Winter with a Differential Platinum Thermometer. By Howard T. Barnes.

Sand-dunes. *Le Globe, B.S.G. Genève* **37** (1898): 22–31. **Ritter.**

Les Dunes. Par M. Étienne Ritter.

This short paper deals with continental or desert dunes, sea-shore dunes, the formation of inverse dunes, small sand-waves—in which the two slopes are different from those of large dunes—on the geographical distribution of the large and the inverse dunes in a chain, and on the dimensions of the constituent sand-grains.

Seismology. *British Assoc. Reports* (1897): 129–206. **Milne.**

Seismological Investigations.—Second Report of the Committee. *With Diagrams.*

This report includes a record of the work done in establishing a seismological survey of the world, accounts of various seismological researches, and of suboceanic changes, all by Prof. John Milne.

Soil Temperatures. **Callendar and McLeod.**

P. & T.R.S. Canada **2** (1896) (Sec. iii): 109–117.

Observations of Soil Temperatures with Electrical Resistance Thermometers. By Hugh L. Callendar and C. H. McLeod. *With Diagrams.*

Terrestrial Magnetism. *P.R.S.* **63** (1898): 64–78. **Ellis.**

On the Relation between the Diurnal Range of Magnetic Declination and Horizontal Force and the Period of Solar Spot Frequency. By William Ellis, F.R.S. *With Diagrams.*

Terrestrial Magnetism. **Naumann.**

Geotektonik und Erdmagnetismus. Von Dr. Edmund Naumann.—Verhandlungen des Zwölften Deutschen Geographentages, Jena 1897. Berlin: D. Reimer, 1897. Pp. 142–166. *Plate.*

Terrestrial Magnetism. **Schmidt.**

Die geographischen Aufgaben der erdmagnetischen Forschung. Von Gymnasial-Oberlehrer Dr. Adolf Schmidt.—Verhandlungen des Zwölften Deutschen Geographentages, Jena 1897. Berlin: D. Reimer, 1897. Pp. 124–141.

Terrestrial Magnetism. **Carlheim-Gyllenskold.**

Sur la forme analytique de l'attraction magnétique de la Terre, exprimée en fonction du temps. . . . Af V. Carlheim-Gyllenskold. Stockholm: P. A. Norstedt & Söner, 1896. Size 9½ × 8, pp. 36. *Presented by the University of Upsala.*

Terrestrial Magnetism. *Ann. Hydrographie* **26** (1898): 21–31. **Schmidt.**

Ueber die Darstellung der Ergebnisse erdmagnetischer Beobachtungen im Anschluss an die Theorie. Von Dr. Ad. Schmidt.

Terrestrial Magnetism. *Terrestrial Magnetism* **2** (1897): 105–114. **Eschenhagen.**

On Minute, Rapid, Periodic Changes of the Earth's Magnetism. By Prof. Max Eschenhagen.

Terrestrial Magnetism. **Leist.**

The Influence of Planets on the Observed Phenomena of Terrestial Magnetism. By Ernest Leist. Moscow, 1892. Size 9 × 6, pp. 1–123. *Maps and Diagrams.* [In Russian.]

Works published by the Physico-Mathematical Faculty of the University of Yuryeff (Dorpat). The data and discussion are given.

Terrestrial Magnetism. *Nature* **57** (1897): 160–163, 180–184. **Rücker.**

Recent Researches on Terrestrial Magnetism. By Prof. A. W. Rücker, F.R.S. *With Diagrams.*

This is a report of the Rede Lecture, an abstract of which appears in the *Journal* for May, vol. xi. p. 522.

Tides. *J. School G.* **2** (1898): 122–132. **Davis.**

Waves and Tides. By W. M. Davis.

A clear and simple statement of the essential principles of wave and tidal motion in water.

Underground Water. *Die Natur* **47** (1898): 17–19, 30–32, 40–41. **Ule.**

Das Wasser im Boden. Von Willi Ule.

Zoogeography. *C. Rd.* **126** (1898): 1358–1361. **Bouvier.**

Note préliminaire sur la distribution géographique et l'évolution des Péripates. Note de M. E. L. Bouvier.

Peripatus is a low form of articulated animal hitherto known only in Central America and the West Indies, the Cape of Good Hope, Australia, and New Zealand. The author shows that it also occurs in Gabun, and is there of a form intermediate between that of Central America and South Africa. The bearing of this fact on the former distribution of land and sea is of some importance.

Zoogeography. *P. R. Dublin S.* **8** (1897): 439–468. **Carpenter.**

The Geographical Distribution of Dragon-flies. By George H. Carpenter, B.SC. *With Map.*

The map shows the approximate range of dragon-fly faunas, and closely corresponds to the faunal regions deduced from the study of the distribution of mammalia.

Zoogeography. *Natural Science* **12** (1898): 100–105. **Duerden.**

The Geographical Distribution of the Actinaria of Jamaica. By J. E. Duerden, B.SC.

This subject is treated as bearing on the question of a former connection between the Atlantic and Pacific across Central America. A considerable amount of agreement has been found between the Pacific coast actinarians of Central America and those of Jamaica.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Geographical Progress. *L'Universo* **8** (1898): 81–86, 97–101. **Porena.**

Il Giubileo della Nuova geografia. Del Prof. Filippo Porena.

The inaugural discourse of the University of Naples summarized, on the progress of geographical exploration during the last half-century.

Historical. **Castanhoso and Pereira.**

Quarto Centenario do Descobrimento da India. Contribuições da Sociedade de Geographia de Lisboa. Dos feitos de D. Christovam da Gama em Ethiopia. Tratado composto por Miguel de Castanhoso publicado por Francisco Maria Esteves Pereira. Lisboa: Imp. Nacional, 1898. Size 10 × 6½, pp. xlviii. and 154.

Historical. **Lopes.**

Quarto Centenario do Descobrimento da India. Contribuções da Sociedade de Geographia de Lisboa. Textos em Aljamia Portuguesa. Documentos para a Historia do dominio Português em Safim extrahidos dos originaes da Torre do Tombo. Por David Lopes. Lisboa: Imp. Nacional, 1897. Size 10 × 6½, pp. 158.

Historical—Cabot. **Dawson.**

The Voyages of the Cabots, latest phases of the Controversy. By Samuel Edward Dawson, LIT.D. From the *Transactions* of the Royal Society of Canada for 1897. Ottawa: James Hope & Co., 1897. Size 10 × 7, pp. 139–268. *Maps. Presented by the Author.*

Historical—Map. *Riv. G. Italiana* **5** (1898): 50–51. ———

Il planisfero portoghese di Bartolomeo Velio (1561) di recente scoperto nel R. Istituto di Belle Arti in Firenze. Di F. L. P.

Historical—Measures. *B.S.G. Madrid* **39** (1897), (Suppl.): 1–14. **Blázquez.**

La milla romana. Por D. Antonio Blázquez.

The conclusions of this discussion are that the Roman mile, deduced by six different methods, is from 1670 to 1672 metres, *i.e.* from 5479 to 5485 feet, instead of 1481 metres or 4859 feet, as formerly held.

Historical—Mlle. Tinné. *Questions Diplomat. et Colon.* **2** (1898): 75–79. **Vuillot.**

Au Sahara. La vérité sur la mort de Mlle Tinné. Par P. Vuillot.

The tribe responsible for the murder of the French traveller, Mlle. Tinné, in 1869 has been the subject of frequent discussion. M. Schirmer having recently recurred to the view that the Tuareg Asjer were guilty of the crime, M. Vuillot here states the case in their favour, and expresses the belief that they have always been loyal to France, and innocent of the murder.

Historical—Vasco da Gama. **Ruge.**

Die Entdeckung des Seeweges nach Ostindien durch Vasco da Gama 1497–8. Vortrag, gehalten in der Gehe-Stiftung zu Dresden am 9 Oktober 1897. Von Prof. Dr. S. Ruge. Dresden: Zahn and Jaensch, 1898. Size 9½ × 6, pp. 48. *Maps.*

Historical—Vasco da Gama. **Ravenstein.**

A Journal of the First Voyage of Vasco da Gama, 1497–1499. Translated and Edited, with Notes, an Introduction and Appendices, by E. G. Ravenstein. London: Printed for the Hakluyt Society, 1898. Size 9 × 6, pp. xxxvi. and 250. *Maps. Presented by the Hakluyt Society.*

This was noticed in the *Journal* for July, p. 20.

Historical—Vasco da Gama. *B.S.G. Lisboa* **16** (1897): 247–389. **Cordeiro.**

O premio da descoberta. (Uma certidão da casa da India.) Por Luciano Cordeiro.

Historical—Vasco da Gama. *Rev. G.* **42** (1898): 161–179. **Gaffarel.**

Vasco da Gama. Par Paul Gaffarel.

Historical—Vasco da Gama. **Aragão.**

Quarto Centenario do Descobrimento da India. Contribuições da Sociedade de Geographia de Lisboa. Vasco da Gama e a Vidigueira. Estudo historico por A. C. Feixeira de Aragão. Lisboa: Imp. Nacional, 1898. Size 10 × 6½, pp. xxxviii. and 304. *Portrait and Plates.*

Historical—Vasco da Gama. **Lima.**

Vesperas do Centenario. O Centenario no Estrangeiro, Conferencia realisada na Sociedade de Geographia de Lisboa no dia 11 de Novembro de 1897. Por Magalhães Lima. Lisboa, 1897. Size 10½ × 7, pp. 30.

Political Geography. *Ann. G.* 7 (1898): 97–111. **Vidal de la Blache.**

La géographie politique à propos des écrits de M. Frédéric Ratzel. Par M. P. Vidal de la Blache.

Based upon Prof. Ratzel's recent work on political geography.

GENERAL.

German Colonies. *Oester. Monats. Orient.* 24 (1898): 13–19, 30–32. ——

Die deutschen Schutzgebiete bei Beginn des Jahres 1898.

German Colonies. **Riebow and Zimmermann.**

Die deutsche Kolonial-Gesetzgebung. Sammlung der auf die deutschen Schutzgebiete bezüglichen Gesetze, Verordnungen, Erlasse und internationalen Vereinbarungen, mit Anmerkungen und Sachregister. Erster Theil. Bis zum Jahre 1892. Auf Grund amtlicher Quellen und zum dienstlichen Gebrauch, herausgegeben von Riebow. Zweiter Theil. 1893 bis 1897. . . . herausgegeben von Dr. Alfred Zimmermann. Berlin: E. S. Mittler und Sohn, 1893–1898. Size 10 × 6½, pp. (vol. i.) xiv. and 706; (vol. ii.) xviii. and 378.

A complete collection of the laws and ordinances relating to the German colonies.

German Colonies—Bibliography. **Danckelman.**

Inhaltsverzeichniss zu den Mittheilungen von Forschungsreisenden und Gelehrten aus den Deutschen Schutzgebieten. Band I. bis X. (1888 bis 1897). Mit Benutzung amtlicher Quellen herausgegeben von Dr. Freiherr von Danckelman. Berlin: E. S. Mittler und Sohn, 1898. Size 9½ × 7, pp. 100.

Königsberg Geographical Society. **Tesdorpf.**

Hundert Versammlungen der Königsberger Geographischen Gesellschaft 1881–1898. Zur 100ten Versammlung im Auftrage der Gesellschaft herausgegeben vom Schriftführer Dr. W. Tesdorpf. Königsberg i. Pr., R. Leupold, 1898. Size 9 × 6½, pp. xii. and 198. *Portraits.* *Presented by the Königsberg Geographical Society.*

This volume comprises a list of members of the Society, and a brief summary of each of the hundred meetings that have been held since the establishment of the Society in 1882.

Mountaineering. *Appalachia* 8 (1898): 361–367. **Douglass.**

Effects of High-Mountain Climbing. By A. E. Douglass.

Mountaineering. **Oberhummer.**

Alpenverein und Alpenforschung. Von Eugen Oberhummer. Wien, 1898. Size 7 × 4½, pp. 98.

Nomenclature. *J. Geology* 6 (1898): 161–170. **Keyes.**

The Use of Local Names in Geology. By Charles R. Keyes.

Statistics. **Craigie.**

Notes on the Subjects discussed at the St. Petersburg Meeting of the International Statistical Institute. By Major P. G. Craigie. Reprinted from the *Journal of the Royal Statistical Society*, vol. lx., part iv. (December, 1897). 1898. Size 8½ × 5½, pp. 54.

A report of the international meeting of statisticians in St. Petersburg, with much interesting material bearing on the relative conditions of the countries taking part, and on various distributions.

NEW MAPS.

By J. COLES, *Map Curator*, R.G.S.

EUROPE.

England and Wales. **Wells.**

Map of Canals and Navigable Rivers of England and Wales. By Lionel B. Wells, M.INST.C.E. Scale 1 : 420,000 or 6·7 stat. miles to an inch. George Falkner & Sons, Manchester and London, 1898. *Price* £2 10*s. in sheets.*

This map shows the present state of inland navigation in England and Wales. By the colouring and manner in which the canals are drawn, the class of vessel by which they can be navigated is shown; those that have fallen into decay are specially distinguished.

England and Wales. **Ordnance Survey.**

Publications issued since June 8, 1898.

1-inch—General Maps:—

ENGLAND AND WALES (revision):—20, 52, 54, 120, 216, 279, 293, engraved in outline. 1*s.* each.

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25-inch—Parish Maps (revision):—

ENGLAND AND WALES:—**Cheshire,** III. 3, 7, 14, 15; IX. 7, 9, 12, 13; X. 14; XI. 2, 7, 9, 13; XVII. 4; XVIII. 1, 9; XXVI. 16; XXVII. 9; XXVIII. 5; XXXIV. 4, 8, 12; XXXV. 1, 9, 15; XLI. 4, 8; XLVIII. 4, 6, 15; XLIX. 1, 3, 4, 5, 15; L. 1; LI. 9; LV. 16; LVI. 2, 3, 5, 6, 16; LVII. 1, 4; LXI. 10; LXV. 8. **Derby.** VII. 15; IX. 14, 15, 16; X. 9, 13, 14, 16; XI. 10, 15; XII. 9, 11, 12; XV. 3, 5; XVI. 1, 2, 3, 4, 5, 7, 8, 10, 11, 12; XVII. 1, 2, 5, 7, 9, 11. **Durham,** II. 14. **Essex,** VII. 16. **Hampshire,** LXXXIII. 4, 6, 10; LXXXIV. 10; LXXXVII. 2, 6; XCIII. 14, 15; XCV. 16; XCVI. 13; XCVII. 4; XCVIII. 2, 3, 4, 10, 14, 15; C. 4, 5, 6. **Hertfordshire,** III. 3, 11; IV. 12; VI. 16; XI. 6; XII. 2; XXIII. 14; XXIX. 6, 8, 11, 12, 14; XXXIII. 3, 4, 7; XXXIV. 1, 2, 3, 4, 9, 13, 14; XXXVIII. 8, 12; XL. 6, 10, 16; XLI. 4; XLIV. 8; XLV. 3, 7. **Kent,** XV. 4, 8; XIX. 3; XXV. 9, 11, 12, 13, 14, 15; XXVI. 2, 6, 9; XXXVI. 4; XXXVII. 16; LXVII. 8; LXX. 2, 4, 6, 8, 10, 11, 12, 14, 15, 16; LXXI. 2, 3, 5, 6, 9, 10; LXXXI. 12, 13, 14, 15, 16; LXXXII. 1, 2 and 6, 9; LXXXIV. 2, 3, 4, 8, 12. **Surrey,** XXXVII. 14; XLIV. 2 and 3. **Sussex,** XLVII. 15; LX. 3, 7, 11, 15; LXI. 4; LXIV. 14, 15; LXV. 10, 11; LXVI. 6; LXXII. 3, 7, 11 and 16. **Westmoreland,** XXVII. 15, 16; XXVIII. 13, 14, 15, 16; XXIX. 5, 8, 9; XXXIII. 3, 4, 7, 10, 11, 12, 13, 14, 15, 16; XXXIV. 2, 3, 4, 6, 8, 9, 10, 11, 13, 14; XXXV. 5 and XXXIV. 8; XLI. 8, 16; XLIV. 14; XLVI. 10; XLVII. 4; LI. 2. 3*s.* each.

Miscellaneous:—One-inch Parish Indexes, printed in colours, showing 25-inch parish maps only: Sheets 274, 299, 300, 301, 302, 304, 315, 316, 317, 318, 319, 329, 330, 332, 333, 344, 345. *Price* 1*s. each.* These are also published showing 6-inch quarter-sheets only. *Price* 1*s. each.*

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Historical Atlas. **Poole.**

Historical Atlas of Modern Europe, from the Decline of the Roman Empire; comprising also maps of parts of Asia and of the New World, connected with European

History. Edited by Reginald Lane Poole, M.A., PH.D., Fellow of Magdalen College and Lecturer in Diplomatic in the University of Oxford. Part xviii. *Price* 3*s.* 6*d.* Oxford: The Clarendon Press; London, Edinburgh, Glasgow, and New York: Henry Frowde, M.A.; Edinburgh: W. & A. K. Johnston, 1898. *Presented by the Clarendon Press.*

Part xviii. contains the following maps: No. 7, Europe in 1360, by C. Oman, M.A.; No. 31, Ireland from 1541 to 1653, by Robert Dunlop, M.A.; No. 79, Western Asia at the time of Saladin, A.D. 1190, by Stanley Lane-Poole, M.A. Each of these maps is accompanied by explanatory letterpress.

ASIA.

China. **Oxenham.**

Historical Atlas of the Chinese Empire. By E. L. Oxenham, F.R.G.S. (late H.B.M. Consul at Chinkiang). Second edition, giving the original Chinese maps with their English counterparts. London: Royal Geographical Society, and John Murray, 1898. *Price* £1 10*s.*; to Fellows of the R.G.S., 17*s.* 6*d.*

The Chinese edition of this historical atlas appeared in 1887, having been compiled by the late Mr. E. L. Oxenham, F.R.G.S., from original maps, and the Chinese works of Chinese scholars. In consequence of representations made to him, Mr. Oxenham decided to issue a second edition of this atlas, containing the original Chinese maps with their English counterparts. His premature death prevented his carrying out his intention, and the Council of the Royal Geographical Society decided to defray the expense of preparing the atlas in its present form for publication.

Indian Government Surveys. **Surveyor-General's Office, Calcutta.**

India, 128 miles to an inch, 1897.—Indian Atlas, Quarter-sheets, 4 miles to an inch: Nos 3 N.E., parts of districts Karachi and Hyderabad (Sind, Bombay Presidency), additions to 1895; 26 S.E., part of district Ratnágiri (Bombay Presidency), 1898; No. 48 S.W., parts of districts Hissar and Karnal and Native States of Patiala and Jind (Punjab), 1898; 52 N.W., parts of Native States, Gwalior, and Indore (Central Indian Agency), Oodeypore, Tonk, Jhallawar, and Kotah (Rajputana Agency), additions to 1891; 52 S.E., parts of district Sangor and Bhopal, Gwalior, Pathari, Kurwai, Tonk, Muhammadgarh, and Nawab Básoda (Native States), additions to 1896; 67 S.E., parts of districts Bareilly, Pilibhit, and Shahjahanpur (North-West Provinces), and Kheri (Oudh), additions to 1895; 69 N.W., parts of Gwalior and Bundelkhand (Central India Agency), and of districts Jalaun, Jhansi, Hamirpur, and Etawah (North-West Provinces), additions to 1894; 71 N.E., part of districts Jubbulpore, Damoh, Mandla, and Narsinghpur (Central Provinces), and of Rewah (Central Indian Agency), additions to 1888; 77 S.E., parts of districts Nellore, Coddapah, North Arcot, and Chingleput (Madras Presidency), 1897; 87 N.W., parts of districts Kheri, Bahraich, Sitapur, Baru Banki, and Gonda (Oudh), additions to 1892; 129 N.E., parts of district Lakhimpur (Assam) and the Miri and Mishmi Hills, additions to 1896.—Skeleton map of district Pubnah, 4 miles to an inch, additions to 1897.—District Burdwan (Bengal), 8 miles to an inch, 1890.—District Dacca (Bengal), 8 miles to an inch, 1890.—District Montgomery (Punjab), 8 miles to an inch, 1898.—Punjab Survey, 1 inch to a mile. Parts of district Hissar (Punjab) and Bickaneer State (Rajputana Agency), Seasons 1867–68, 1882–84, corrections to 1895.—Bengal Survey, 1 mile to an inch. Parts of districts Lohardaga and Singhbhum (Bengal), Seasons, 1863–65, additions to 1892.—Central India and Rajputana Survey, 1 inch to 2 miles. Sheets: Nos. 161, 162, and 194, 195 (on one), part of Jeypore, Jodhpore, Bickaneer, and Shaikhawati (Rajputana Agency), Seasons 1875–77, additions to 1896; No. 252, parts of district Hissar (Punjab) and Bickaneer State (Rajputana Agency), Seasons 1867–68, and 1882–84, additions to 1895; No. 441, parts of district Jubbulpore (Central Provinces), and of Panna, Ajaigarh (Central India Agency), Season 1856–57, 1866–67, 1869–70, additions to November, 1897.—North-West Provinces and Oudh Survey, 1 inch to a mile; No. 13, districts Saharanpur (North-West Provinces), and Umballa (Punjab), Seasons 1878–80, additions to 1897.—Lower Burma Survey, 1 mile to an inch; No. 281, districts Hanthawaddy, Pegu, and Rangoon Town, Seasons 1881–83, corrections to 1897; No. 447, districts Amherst and Thaton, Seasons 1891–96, additions to 1897.—North-Eastern Frontier, 16 miles to an inch. Sheet: No. $\frac{5\text{–}12}{6\text{–}13}$, parts of Great Tibet, Sikkim, Assam, and Bhután, 1897.—Burma-Siam Boundary, 1 inch to a mile, 6

sheets, 1897.—Index to the Standard Sheets of Sind (Bombay Presidency).—Chart of Triangulation and Traversing, Gujarat Survey. Degree Sheet 10, ¼ inch to 1 mile.
(*E. Stanford, Agent.*)

AFRICA.

German East Africa. **Capus.**

Reiseroute der Missionare Pères van den Biesen, Capus und van der Burgh, von der Station N. D. Auxiliatrice in Ushirombo nach Uha und Urundi. Juni u. Juli, 1895. Nach einer Originalskizze de Père Capus. Scale 1 : 350,000 or 5·5 stat. miles to an inch. *Petermanns Geographische Mitteilungen.* Jahrgang 1898, Tafel 9. Gotha : Justus Perthes. *Presented by the Publisher.*

Tunis. **Service Géographique de l'Armée, Paris.**

Carte de la Tunisie. Scale 1 : 50,000 or 0·7 stat. miles to an inch. Sheet : Environs de Tunis. Publié par le Service Géographique de l'Armée, Paris. *Price* 1.5 *fr.*

GENERAL.

The World. **Andree.**

Andrees allgemeiner Handatlas, 126 Haupt- und 130 Nebenkarten auf 186 Kartenseiten, nebst alphabetischem Namenverzeichnis. Vierte, völlig neubearbeitete, stark vermehrte Auflage, herausgegeben von A. Scobel. Bielefeld und Leipzig : Verlag von Velhagen & Klasing, 1898.—Lief 17, Karte der Nordpolarregion : Europäisches Russland.—Lief 18, Provinzen Brandenburg, Pommern und Posen : Spanien und Portugal.—Lief 19, Verbreitung der Wichtigsten Wild- und Kulturtiere : Nordwestliche Vereinigte Staaten und Südwestliches Canada.—Lief 20, Deutsches Reich, Staatenübersicht : Norditalien : Sizilien und Sardinien.

The World. **Bartholomew.**

The Citizen's Atlas. One hundred maps and gazetteer. By J. G. Bartholomew, F.R.G.S. Published by George Newnes, Ltd., London. To be completed in 20 parts. Parts 9 and 10. *Price* 6*d. each.*

CHARTS.

North Sea. **Olsen.**

Chart of the North Sea. Scale 1 : 815,000 or 12·8 stat. miles to an inch. Compiled by O. T. Olsen, F.L.S., F.R.G.S., for the use of fishermen. Published by Norie & Wilson, London, 1898. *Presented by the Author.*

PHOTOGRAPHS.

British Central Africa. **Codrington.**

Eleven Photographs of Angoniland, British Central Africa, taken by R. Codrington, Esq., 1891–92. (1) Bows and arrows of the Achewa ; (2) Knives and spears of the Achewa ; (3) Yao warrior; (4) Yao woman pounding mealies ; (5) Yao woman with Lip-ring (Pelele) ; (6) Angoni warrior ; (7) Stabbing assegais of the Angoni ; (8) Dress of the Angoni warrior ; (9), (10), (11), no titles. *Presented by R. Codrington, Esq.*

Greenland. **Peary.**

Twenty-eight Photographs of North-West Greenland taken during the explorations of Lieut. E. A. Peary, U.S.N , 1891–92. *Presented by Lieut. E. A. Peary, U.S.N.*

This is a most interesting series of photographs taken by Lieut. Peary, U.S.N., during his stay in Greenland and journey to Independence bay. As the titles will show, they illustrate many incidents which took place during his adventurous journey and phases of Esquimo life, as well as the physical features of the country.

(1) Sailing on the Inland ice ; (2) Glacier of the Scarlet Heart ; (3) Eskimo woman, Whale sound ; (4) Ice Cap camp ; (5) Red Cliff House, 91–92 ; (6) A breakdown on the Ice Cap ; (7) An August day in McCormick bay ; (8) Sastrugi of the inland ice ; (9) Taking an observation ; (10) Eskimo house-building ; (11) Eskimo group ; (12) Red Cliff House ; (13) Fœtal glaciers, McCormick bay ; (14) Eskimo mother ; (15) The Stars and Stripes on the Cairn at Independence bay, Independence bay in the distance ; (16) Josephine headland, Northumberland islands ; (17) Littleton island ; (18) Eskimo mothers, Whale sound ; (19) October at Anniversary Lodge ; (20)

Anniversary Lodge, 1893–95; (21) Beset off Cape Mercy; (22) Eskimo young man, Whale sound; (23) Eskimo woman, Whale sound; (24) On the Great Ice; (25) Moving the big meteorite; (26) Gnome glacier; (27) Icing sledge shoes; (28) Bowdoin glacier.

Manchuria. **Smith.**

Thirty-two Photographs taken by Dr. Donaldson Smith during his journey through Manchuria, 1897. *Presented by Dr. Donaldson Smith.*

The following is a list of the titles of these photographs:—

(1) Mongolian spotted deer; (2) Yang Shu Pai; (3) A group of Mongols; (4) Salt caravans; (5) Main street of Tsitsihar; (6) Main street in Tsitsihar; (7) Prince Nau Hang Wang; (8) Prince Nau Hang Wang; (9) The "belle" of the Mongols, on the banks of the river Tshor; (10) Chinese junks at Tsitsihar; (11) San Ti Ying, temple and hot springs; (12) The Sungari river from a cattle boat; (13) Taking cart across the river Torre in ferry boat; (14) A Golde (one of the natives of the upper Amur districts) at a railway station near Vladivostock; (15) Mongol village, Hu Pu; (16) At the junction of the Amur and Sungari rivers; (17) Statue of the first governor of the Amur provinces at Kabasopka; (18) Entrance to Lamasery at Ching Pong; (19) Shiao Ho Tsu; (20) Ta Lai Hu Shu; (21) La Ho Ku, Mongols in camp; (22) The river Tshor at Pu La Su Ku, Lamasery in the distance; (23) The river Tshor at Pu La Su Ku; (24) The flooded Nonni; (25) A Nonni steamer on the Amur; (26) Lamas; (27) Mongol women; (28) Mongol village; (29) A Lama and some of his relatives examining a camera; (30) Temple and graves outside of walled town, Shi Hia; (31) Lassooing pony at Dolon Nor; (32) No title.

North-West Frontier of India. **Tate.**

Thirty-four Photographs taken in the neighbourhood of the Railway to Kandahar, by G. P. Tate, Esq. *Presented by G. P. Tate, Esq.*

This set of photographs contains different views of the railway to Kandahar, types of natives, some interesting geological features, and the scenery of the adjacent country. The following is a list of the subjects:—

(1) Chitkan of Panjgur, showing huts for troops in 1892; (2) Village of Turbat in Kej; (3) Types of inhabitants, Kej; (4) Village of Gushtang, in Kej (Makran); (5) Fisher village on the Kalmat creek; (6) Cavalry lines in Chitkan of Panjgur, 1891–92; (7) Tennis court at Chitkan of Panjgur, 1891–92; (8) "A bit" in Panjgur; (9) Fort at Pidárk, Makran; (10) Village on the Kalmat creek, Makran coast; (11) Mir Muhamad Ali Khan, Gichki, Sardar, and Khan's deputy in Panjgur; (12) "A bit" in Panjgur; (13) Fort at Khudabadan, Panjgur; (14) Officer's quarters, and hospital for troops and civil patients, Chitkan of Panjgur, 1891–92; (15) Fort at Hor, Kolwah valley, Kej; (16) General view in Kej, 1891–92; (17) "A bit" in Panjgur; (18) Miri fort in Kej; (19) Bridge near the Mushkáf railway, showing sandstone ridges; (20) "A bit" in Mushkáf-Bolan railway, showing clay and recent stratified rock (sandstones) forming cliffs in Mushkáf river; (21) Inside Kalmat creek, Makran coast, 1891–92; (22) "A bit" showing relative position of railway line as first constructed, and the "high-level" line now in use and recently finished; (23) Railway bridge near river at Mach, Bolan pass; (24) The railway station at Hirok, Mushkáf-Bolan railway; (25) "A bit" on the Mushkáf-Bolan railway; (26) The Laleji plain in Mushkáf-Bolan railway, clay hills capped with sandstones, and containing layers of same; (27) A bridge on the Mushkáf-Bolan railway, showing piers constructed for double line of rails if required; (28) Bridge and tunnel on Mushkáf-Bolan railway; (29) Tunnel through watershed near Kolpur; (30) Kolpur station, and houses of officers and staff, Mushkáf-Bolan railway; (31) "A bit" on railway line near Hirok, showing nature of hills; (32) General view of portion of the line; (33) "A bit" on the Mushkáf-Bolan railway, showing stratified recent sandstones; (34) Mushkáf-Bolan railway, "A bit" in the Bolan pass, showing nature of hills.

N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

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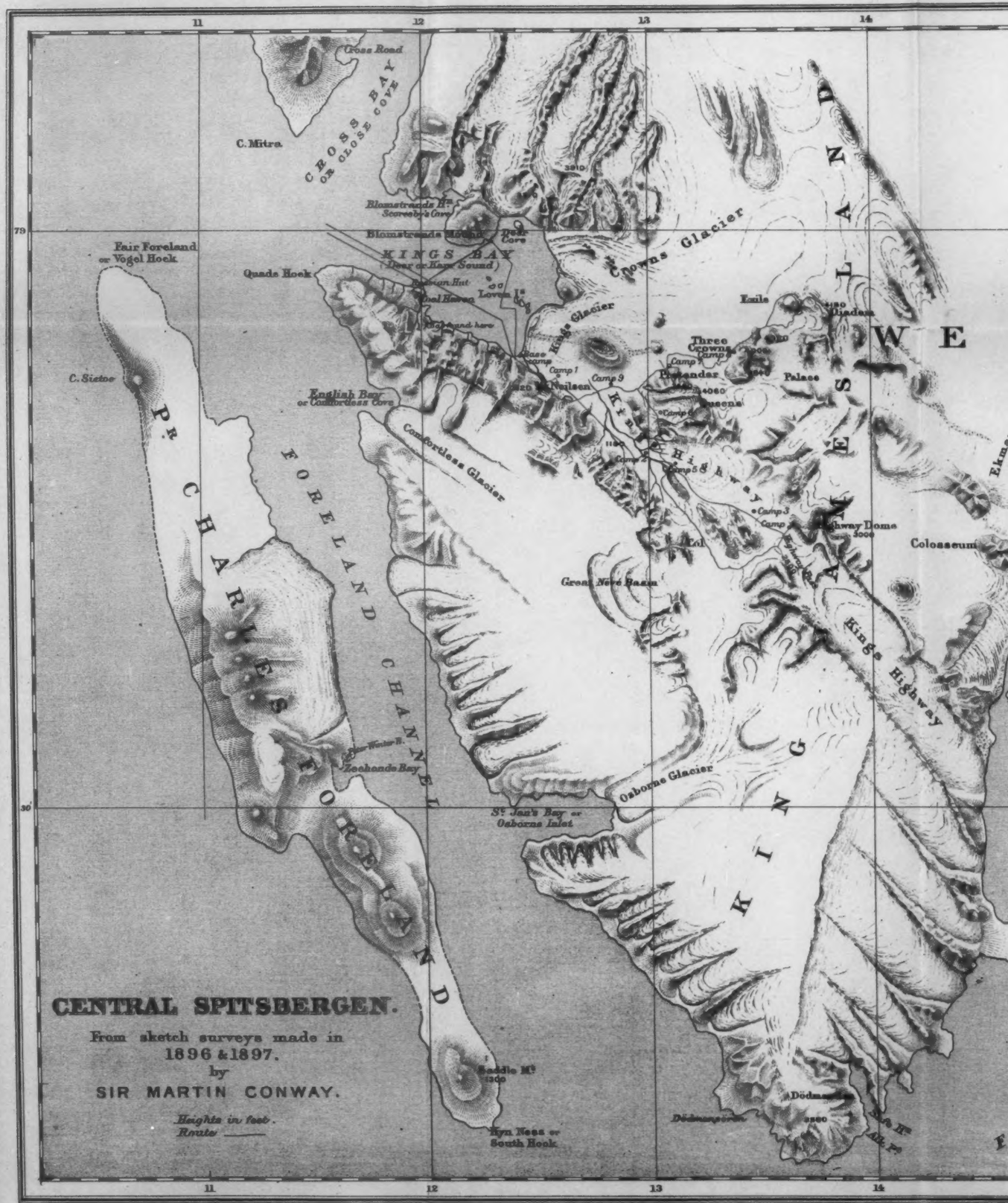
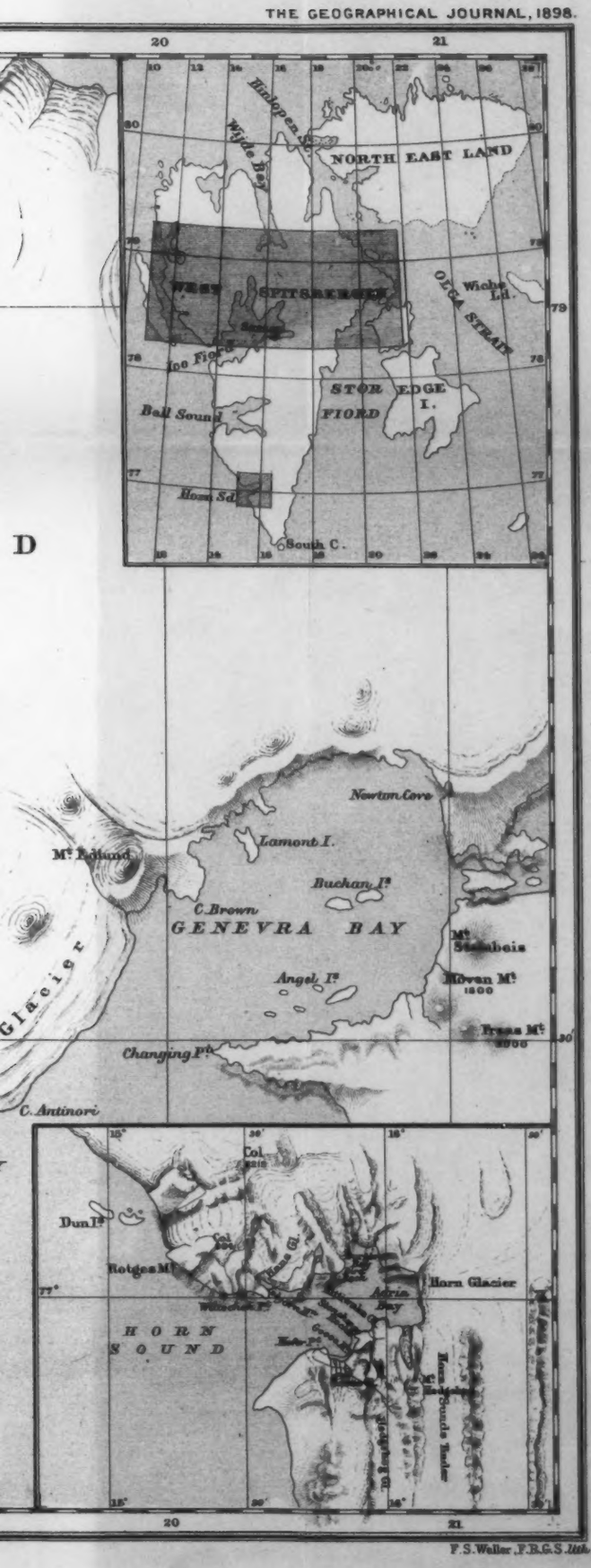
Bartholomew. Edin.r

Geographical Society.


11
12
13
14
79
80
Cross Road
CROSS BAY
OR CLOSE COVE
C. Mitra
Blomstrandø H.
Scoresby's Land
Blomstrandø Island
Tron Cove
KINGS BAY
(Deer or Hare Sound)
Fair Foreland
or Vogel Hook
Quade Hook
Boatman Hut
Lovén Ld
Kings Glacier
Crowns Glacier
Exile
Diadem
Three Crowns Camp
Three Crowns
Camp 7
Camp 1
Camp 9
Base Camp
Camp 10
Pinnacles
Palace
Museum
C. Sietze
English Bay
or Comfortless Cove
Comfortless Glacier
Kings Highway
Camp 5
Camp 3
Camp
Highway Dome
Colosseum
Great Nave Basin
Kings Highway
PR. CHARLES FORELAND
FORELAND CHANNEL
KING
Zeehonde Bay
Osborne Glacier
St. Jan's Bay or
Osborne Inlet
Saddle Mt
1300
Ryn Ness or
South Hook
Dödmansöen
Dödmansö
CENTRAL SPITSBERGEN.
From sketch surveys made in
1896 & 1897.
by
SIR MARTIN CONWAY.
Heights in feet.
Route

15
16
17
18
19
EAST FIORD
WEST FIORD
Shallow
Mt. Sir Thomas
High Mountains here
Heydenius?
Snow Dome
Camp 4 3000
Camp 5
Camp 3
Snow Valley
ST SPITSBERGEN
GARWOOD LA
Trevor Roberts (67)
Elman Glacier
Swamp
The Castle Red Hill
Lyktan (Lighthouse)
Giants Chair
Nathorst
The Citadel
Ekman Bay
Island
Table Taage
DICKSON BAY
C. Smith
De Geer's Peak 4000
Camp 2 1500
Camp 6
Camp 1 700
Nordenskiold Glacier
Torrier
White Cathedral
Svan
Mines B.
Base Camp
Mountain Group
C. Wiarn
C. Wyle
NORD
FIORD
Ischermaks-berg
KELVIN BILLEN BAY
Cape Boheman
SASSEN BAY
Mt. Temple
Post Glacier
TEMPLE B.
COLORADO RIDGE
Mt Baird
Mt Tiset
Corrie Dome 1500
Col 1070
Mt Lessimann 3120
Zero Gris Ridge 2130
Trident Peaks 1950
Babot Gl.
Hayes Gl.
HORN B.
Krogh Mt.
C. Johan
Published by the Royal Geographical Society.

17
18
19
EAST FIORD
High Mountains here
Snow Dome
Camp 4 3000
T S B E R G E N
Camp 5
Snow Valley
Camp 3
G A R W O O D L A N D
De Geer's Peak 4000
Camp 2 1800
Camp 6
Nordenskiold Glacier
Terrier
White Cathedral
Svanberg
Camp 1 700
Base camp
Mountain Group
BILLEY BAY
White Pk 2930
Gipps Gl.
Mt Temple
Lost Glacier
TEMPLE B.
WICHE BAY
COLORADO HILLS
Mt Baird
Mt Peschel
Mt Tiset
Rabot Gl.
Hayes Gl.
Trident Peaks 1800
Krogh Mt.
C. Johannesen



F.S. Weller, F.R.G.S. lith.

66 68 70 72 74 76

Biely I. (White)

C. Iranor
C. Regesin
C. Shubaré
Malygin
Malygin St.
C. Shuratar
C. Galerka
C. Khayen
R. Vada
C. Droriany
C. Tura sal.
Vilkitski I.
C. Matveev
C. Paiuda
R. Paiuda
R. Niutteh
C. Ebtarma
R. Ebtarma
R. Sedai
R. Niasedai
R. Siador
R. Yun
R. Puya
R. Niadaty
R. Tombei
C. Taran
C. Kharasavei
Khaypudi
Koshka
YALMAL PENINSULA
Krusenstern Bay
R. Ptardaty
C. Yasalei
C. Mordy
R. Mordy
C. Tarui
C. Biely
C. Lebedinoi
Bare Tundra
C. Belouga
R. Niaby
Mutnoi B.
C. Mutnoi-salah
Lutka
C. Soletoi
Gulf of Baidaratsky
R. Narulta
Gulf of Tiroyai
R. Oi-yaga
R. Tyrata
R. Kasta
R. Tora
R. Conora
R. Tambat
R. Khals
R. Iorkut
R. Yanaar
R. Baidaratta
Samoyeds
R. Yurubey
C. Minga
C. Troitsk-Iugorny (C. Three Points)
C. Poveretny
C. Kamenny
C. Frugly
C. Paruinoi
C. Setnoi
C. Kochuyrsch
C. Dosada
C. Vambury
Summer camping ground of Kalmuk Samoyeds
Summer camping ground of Nizovy Samoyeds
Nahadka B.
C. Soletta
C. Uskat
C. Ostrovnoi
C. Peschany
C. Kydaky
C. Lynsita
C. Nare
R. Pinderata
R. Kirubeh
Yarmak I.
Serkamo I.
Khe I.
OBDORSK
Gulf of Ob
Great Yarubeh
Lesser Yarubeh

Published by the Royal Geograph

78 80 82 84 86

72 70 68 66

Reshetnye
Uboina
Kuskin I.
Port Dickson
Vermes R.
C. Yevreinov
Kusku I.
Sibiriakov
G U L F O F
Y E N I S E I
C. Menin
C. Krestovsky
Krestovsky I.
R. Glubokaya
C. Preobrazheniya (Shtandarsky)
Zverevo
Gol'chikha village
Sv. Inokentiya B. (St. Innocent)
C. Darofeyev
Lake River
Verentsovo
R. Yunega
C. Gustinny
L. Verentzova
R. Yara
R. Sidiyakha
Polikarpovsky
Kargapolskaya
Nosok
R. Güda
T u n d r a
R. Tolstaya
R. Yara
Nosok
Lachygino
Smirnagino
Andreyanovsky
Shirokaya Iugi
Mukhanikha
Tolstanovo
Polaty nos
P. Kosarka
R. Pluzhky or Yarudskaya
Dudinka vil.
Dudinka R.
R. Schanaya
G. Thaia R.
C. Vriamskikov
G U L F O F T A Z O V
Blizky
Kamburg I.
R. Nadezhda
C. Kosheleusky
R. Miatso
Pud R.
E N I S E I R I V E R
S E A

CHART

Shewing changes of the coast at the entrance of

OBI & YENISEI RIVERS

Surveyed by

THE VILKITSKY EXPEDITION

1894 - 1896.

- Astronomical and magnetical points.
- Astronomical points.
- Coast surveyed by the expedition.
- Coast from old charts.
- Soundings in fathoms.

ographical Society.